INTERIM REPORT

STORM WATER MANAGEMENT IN THE WASHINGTON, D.C. METROPOLITAN AREA

Prepared by the

Storm Water Management Task Force,

Environmental Engineering Committee

National Capital Section,

American Society of Civil Engineers

June, 1975

RECEIVED
FEB 3 1975
MONTGOMERY SOIL
CONSERVATION DISTRICT

INTERIM REPORT

STORM WATER MANAGEMENT IN THE WASHINGTON, D.C. METROPOLITAN AREA

Prepared by the

Storm Water Management Task Force,

Environmental Engineering Committee

National Capital Section,

American Society of Civil Engineers

June, 1975

* * *

Storm Water Management Task Force Members

William A. Caruthers, Jr., Chairman
Nazir Baig
Conrad Brewer
William Bromley
Stephen Chan
Donald Chapman
Thomas Currin
Carlos Duque
William Elliott
Carl Izzard
Payne Johnson
Dr. Ernest Liou
John Morris
Michael Pavlides
Walter Petzold
Dr. Chin-Lien Yen

Environmental Engineering Committee Officers (1974-75)

Charles D. Kepple, Chairman
George W. Keyes, Vice Chairman

AMERICAN SOCIETY OF CIVIL ENGINEERS

NATIONAL CAPITAL SECTION

FOREWORD

The National Capital Section, American Society of Civil Engineers, has embarked upon a program of assisting public understanding of engineering-related matters that are of substantial public interest in the Washington, D. C. Metropolitan Area. This program includes: (a) presenting at appropriate public hearings formal statements on certain public issues involving technical problems; and (b) compilation of a series of brief reports on certain environmental issues summarizing the essential facts of problem situations, and stating--on behalf of the technical community-- a consensus of how best to resolve these situations. Reports entitled: "Solid Waste Disposal in Selected Jurisdictions in Metropolitan Washington" and "Implementation of Water Supply and Wastewater Programs in the Metropolitan Washington, D.C. Area," have been compiled. The Section also has adopted resolutions in Clean Air and on Noise Control.

The Environmental Engineering Committee of the NCS has been compiling data, during the past year, on practices and programs for Storm Water Management in the Metropolitan Area, in order to evaluate the effectiveness of existing programs and make recommendations concerning Storm Water Management policies. The enclosed Interim Report, endorsed by the governing board of the National Capital Section, ASCE, is offered as a preliminary document for information purposes to public officials and other interested bodies. A final report is planned. We sincerely hope that you will find this report helpful in future deliberations on matters relating to the management of storm water runoff. Comments would, of course, be welcomed. They should be directed to Mr. Robert D. Wolff, Secretary, National Capital Section, ASCE, Office, Chief of Engineers, (ATTN: DAEN-CWP-A) Washington, D. C. 20314.

Homer B. Willis

HOMER B. WILLIS
President

INTERIM REPORT: STORM WATER MANAGEMENT PROGRAMS IN THE WASHINGTON, D. C. METROPOLITAN AREA

Whereas, the National Capital Section (NCS) of the American Society of Civil Engineers (ASCE) is concerned about the Area's storm water management problems;

Whereas, a functional storm water management capability is vital to the health and well-being of the Area's inhabitants, its commerce, and its industrial activities;

Whereas, numerous technically feasible measures have been proposed to ameliorate these problems;

Whereas, the time that will be needed to carry out many of these measures is in the order of years, such that inaction now could have extremely serious consequences in the future;

Whereas, as described in detail in the accompanying report, the major factors inhibiting action are organizational weakness, lack of jurisdictions having authority over various aspects of water-related activities; and

Whereas, funding problems, serious in themselves, are magnified by the aforementioned organizational weaknesses;

Now therefore be it resolved that the National Capital Section endorses the attached report and the conclusions detailed therein; and

Be it further resolved that the National Capital Section has prepared this Interim Report:

1) to, reflect the concern of professional engineers that correct storm water management policies be implemented;

2) to, determine to what extent storm water management objectives are now practiced;

3) to, determine by use of a questionnaire, which local governments have storm water management policies, plans, and to funding;

4) to, encourage local governments to establish storm water management policies.

TABLE OF CONTENTS

Chapter		Page
	Resolution of Endorsements.....	ii
	Table of Contents.....	iii
I.	Introduction.....	1
II.	Observations of the Questionnaire Data.....	2 - 3
III.	Storm Water Management Discussion	3 - 9
IV.	Survey Matrix.....	10 - 11

APPENDIX

A	Questionnaire	21 - 22
B	Detailed Responses to Questionnaire	23 - 57

INTERIM REPORT

STORM WATER MANAGEMENT IN THE

WASHINGTON, D. C. METROPOLITAN AREA

I. INTRODUCTION

The development of Storm Water Management as a technique separate from traditional methods of storm sewer design and flood control is a relatively recent phenomonon. As a means of modifying the adverse affects of urbanization upon developing watersheds, storm water management has attracted much interest from public agencies, environmental groups, academic research groups and developers in addition to the design professionals.

The Washington, D. C. Metropolitan Area has several jurisdictions that require on-site storm water management and some of the regulations and techniques have been pioneered here. A number of regional watershed studies relating to storm water management have been undertaken by governments in the National Capital Area. Numerous advisory groups have been formed and formal regulations requiring storm water management or modifying existing requirements are under consideration in most of the local jurisdictions.

The National Capital Section, ASCE, a group of concerned professionals, recognized the need for an engineering input in the evaluation of the many programs planned and discussed at the local level. A task force on Storm Water Management was formed by the Environmental Engineering Committee in 1974 for the following purposes:

1. Determine the extent of the existing plans and programs for Storm Water Management in the area.

2. Evaluate the effectiveness of the programs and techniques by drawing on the experiences of the administrators and engineers actually involved.

3. Make recommendations that would serve as a basis for testimony at public hearings, etc. on proposed plans as they are put forth in the future.

The Interim Report has utilized a questionnaire that was directed to all known agencies and departments involved or interested in Storm Water Management in the Metropolitan Washington, D. C. area. In most cases a personal interview was set up with the individual most directly concerned.

A future report will utilize a questionnaire sent to engineers and public agencies involved in storm water management in order to evaluate the effectiveness of the existing programs. The Task Force will be able to make a review of the various consultant studies on Storm Water Management at that time. This activity will lead to recommendations concerning Storm Water Management policy that will be incorporated into the final report.

II. OBSERVATION OF THE QUESTIONNAIRE DATA

The tabulated results of our questionnaire indicate a wide range of definitions and goals for Storm Water Management. The statement formulated by Mr. Donald Chapman of the Prince George's County Department of Public Works and Transportation is succinct yet encompasses most of the ideas contained in the other responses. It defines storm water management as "The total of all measures taken to regulate storm generated run-offs and stream flows to reduce adverse environmental and economic impacts."

Specifically stated or implied in most of the definitions is the modification of stream flows to offset the increased run-off due to urbanization. The prevention of flooding or property damage is specifically referred to in half of the statements. Prevention of stream bank erosion, although specifically mentioned only once, seemed to be implied in over half the statements. Water quality as a goal of storm water management was specifically mentioned by three of the agencies. This correlates with the low level of activity and funds committed to water quality by the responding agencies. Ground water recharge is another subsidiary concern that is mentioned in one of the responses but does not appear to be in any of the current action programs.

The survey reveals that there is a high level of commitment to storm water management in Montgomery and Fairfax Counties. This is borne out in the establishment of design criteria, mandatory on-site requirements, enforcement of standards, comprehensive watershed studies and budgeting for design and construction of publically financed storm water management projects. In Fairfax County a bond issue commitment of eleven million dollars has already financed a 1.7 million dollar study. In Montgomery County, past projects such as the P. L. 566 impoundments at Lake Needwood and Lake Frank, will be followed by 1.2 million dollars worth of design and construction money for storm water management projects as outlined in the Six Year Capital Improvements Program. In Prince George's County the situation is less clear with only limited commitment to storm water management and no consensus as to what role the interested agencies will play in storm water management. In the District of Columbia there seems to be no movement at all towards storm water management except for a study of erosion problems conducted by George Washington University. The municipalities have taken a problem related approach to storm water management characterized by the responses from Fairfax City and Alexandria. One common difficulty voiced by almost all was development of a satisfactory maintenance arrangement for Storm Water Management devices. Questions were raised concerning who would maintain and/or pay for maintenance and what was the best method of achieving same.

From our survey, it becomes clear that while only two of the five major metropolitan jurisdictions have strong storm water management programs, all but the District of Columbia are considering or developing storm water management programs. In the District of Columbia the emphasis is on the separation of storm and sanitary sewers in the older parts of the city. There are relatively few open streams (other than Rock Creek) that remain to be protected. Of the 6,550 acres of land in the Washington Metropolitan Area that are projected to undergo urbanization each year, three-quarters lie in the two jurisdictions best equipped to implement storm water management.

The survey reveals that within the same watershed, but in several political jurisdictions, the storm water management criteria, policy and practices vary significantly. This situation, if it continues, will tend to dilute the objectives of storm water management, since the storm water management facilities should be located strategically within a watershed. Conversely, there should be an evaluation of the storm water management policy, criteria and practices to see if it meets its intended objective and with reasonable cost effectiveness. Maintenance costs should be included in this analysis. Maintenance was a major concern of all public agencies.

III. STORM WATER MANAGEMENT DISCUSSION

What is Storm Water Management?

The term "Storm Water Management" has recently come into use to encompass all aspects of anticipating and providing for safe handling of run-off with due consideration to protection of the environment and to all of the costs associated with the system from the planning stage to operation and maintenance and repair of flood damages. Within the context of this report, and as generally used, the term applies only to urban and suburban areas, but including the rural areas destined to be developed.

In the past the usual practice was to collect the water into ditches and roadway gutters, drop it into storm sewers and get rid of it as quickly as possible. The result was a many-fold increase in the peak rate of runoff as compared to the peak flow from the same area before development. Natural channels were severly eroded. Flooding would occur on downstream lands never before flooded. Practically no consideration was given to control of erosion during construction with the result that tons of sediment were depoisted in streams to the detriment of aquatic life.

The current emphasis on Storm Water Management comes from the recognition that such damage to the environment could be alleviated if not eliminated by improved practices, and ultimate costs to the public reduced at the same time. Some inconvenience to the public will remain since the cost of total elimination of such inconvenience would not be justified.

The Storm Water System

The storm water system includes, first of all, the natural drainage system, lot grading of swales to convey storm water away from houses to natural or artificial channels including street gutters, culverts, inlets and storm water pipes, energy dissipators at outlets, ponds for temporary or permanent storage together with outlet works, roof top and parking lot storage, ground water recharge basins, and treatment plants to remove pollutants if required separately from the sewage treatment plant.

Philosophy of Storm Water Management

The philosophy of storm water management is that the system should provide for runoff from minor storms with only minor inconvenience to the public and yet be so designed that major storms can be accommodated without hazard of serious injury or loss of life to anyone and with minimum damage to property both public and private.

For example, during frequently occurring storms of low intensity there will be water flowing in swales on private land and in gutters on streets, water accumulating in ponding areas on parking lots and detention ponds, all of which would drain away quickly after the rainfall ceased. Traffic would still move freely, though cautiously, on streets

and parking lots while pedestrians would experience some inconvenience. For the infrequent storm of high intensity, the major storm water in all channels would be much deeper; storm drain pipes would be running full with excess water flowing down gutters possibly impeding traffic; at low points curbs may be overflowed with water flowing overland to the natural or other open channel possibly with some damage; detention ponds would be discharging through overflow spillways with perhaps some damage at outlets and in outlet channels.

Objective of Storm Water Management

The objective of storm water management is to minimize the overall cost of providing, operating and maintaining the storm water system. Stated more fully the annual costs of building the storm water system plus the annual costs of operating and maintenance plus the annual cost of damages incurred publicly and privately, all averaged over a period of years will be the minimum of the total of such costs estimated for each of several alternative systems. It must be recognized at this point that in addition to the out-of-pocket costs and expected benefits traditionally associated with engineering economics, there are cost benefits in terms of prevention of downstream erosion, preservation of ecological balance, protection of life and property which are difficult to quantify. Reducing all costs to average annual costs is essential for fair comparison of alternatives since (1) capital costs must be amortized over a period of years, and (2) the maintenance and damage costs must be averaged over the same period of times. Practically this objective is hard to meet mainly because of the difficulty of reliably estimating what damage costs, and to a lesser degree, maintenance costs, are likely to be for a proposed system. Nevertheless, the concept should be kept in mind.

Some rough figuring on the average annual cost of building a storm water system to safely accommodate a storm likely to occur only once in 100 years with only minor inconvenience to the public will clearly show that this investment is unreasonable. At the other extreme, if the system is built for a two year storm with no provision for taking care of larger storms, the damage that would be sustained over even a ten year period would be intolerable. In the latter case, a major item in the damage cost would be the delays to traffic caused by flooded streets; the damage to private property would also be large. Somewhere between these extremes lies the minimum overall average annual cost.

The uninformed public usually looks only at the capital cost and taxpayers will argue for reducing it as much as possible. It is the task of the engineer to provide information to the governing body to demonstrate effectively that a somewhat greater first cost will in the long run reduce costs to the taxpayer by reducing the costs of repairs of flood damage. In addition, however, the public must also be given the opportunity to judge how much more it is willing to add to the first cost in order to achieve environmental goals and certain amenities such as landscape enhancement. The best measure of this may be in the approval of a bond issue to acquire parkland on the flood plain of a natural stream, as an example. Also, one may observe that lots with scenic outlooks, as on a lake, are always valued higher than the same size lot not having such a view.

The cost of the storm water system is paid by the owner whether in the cost of the lot or in taxes paid to fund bonded indebtedness. With the need for low-cost housing for a segment of the population, the developer and the county (or city) may elect to provide a lower standard of storm water system, or through subsidy from general funds provide the same standard for all developments. On the other hand, in a commercial development the intensity of use may require a higher standard with the cost to be paid by the owners (and passed on by rental charges which are figured into the cost of doing business).

The alternatives open to the developer for possible storm water systems may be constrained by the criteria or standards prescribed by the governing agency. Consequently, the latter should be careful not to prescribe standards which eliminate alternatives viable in the economic sense.

The public agency thus has a major responsibility to make its own engineering economic analyses of the possible effects of standards it prescribes regarding storm water systems, and more broadly of policies regrading storm water management as a whole. To a considerable degree, federal and state legislation has established policies which must be followed at the local level with respect to:

(1) flood plain management (to conform to HUD requirements if flood insurance is to be obtained)

(2) erosion control and pollution

  (a) discharge of pollutants into natural waters (National Environmental Policy Act)

  (b) erosion control as one aspect of pollution control (Both Maryland and Virginia have laws requiring erosion control. The District of Columbia does not).

(3) land use legislation has been pending at the federal level and may ultimately bear on local storm water management through a state authority.

Some principles of storm water management have been widely accepted around the nation. In many respects local jurisdictions in the Washington Metropolitan Area have been pioneers in the adoption of these principles. The highlights are given in the following section.

Some Principles and Recommended Practices with Regard to Storm Water Management

The major principles which ought to be considered in development of policies with respect to Storm Water Management are listed below--not necessarily in any order of priority. The list covers only broad principles which should be of interest to governing bodies who establish policy and to administrators who must first of all recommend, and then implement, the policy after acceptance by the governing body.

(1) Regional planning of storm water systems should normally be based on whole watersheds. Piecemeal design by individual subdivisions regardless of the remainder of the watershed above and below can lead to wasteful results and lost opportunities for optimal design.

Such watershed planning is underway in Fairfax County in Virginia. In the suburban Maryland area, the Maryland National Capital Park and Planning Commission has taken an increasing role in watershed planning with studies on the Anacostia and Seneca Watersheds encompassing a large portion of the urbanizing area.

(2) Storm water systems should be designed to function with little or no inconvenience to the public for frequently occurring (minor) storms and to function without serious hazard to life or property for infrequent (major) storms.

(3) Storm water system planning should be an integral part of preliminary land planning and development and not something superimposed later.

(4) To the extent possible, maximum use should be made of the natural stream channels thereby enhancing environmental, aesthetic and conservation values where present. At the same time, the need for underground storm drains will be minimized thereby reducing the investment cost. Implementation of (5) below will help to prevent erosion of natural channels by limiting peak flows to those which shaped the channel originally.

The stream valley parks of M-NCP & PC, District of Columbia, Arlington and Fairfax Counties are good examples of this practice on a large scale. It should be followed more extensively on smaller streams.

(5) The maximum flow in the receiving stream should be no greater from proposed development than that existing before development. This usually requires storage.

Through a policy of restricting peak runoff to contain levels prescribed in their criteria, Fairfax and Montgomery Counties have sought to implement this goal. This policy has been implemented in Prince George's County in a more selective fashion.

(6) In furtherance of runoff control under (5) use of permanent or temporary ponding, parking lot or roof top storage and other detention devices is recommended wherever applicable. Design should give consideration to safety, visual appearance, maintenance, and in the case of permanent ponds, the opportunity for recreational use.

The Maryland Water Resources Administration is preparing a manual on the design of storm water management facilities as is the Fairfax County Department of Public Works. The Maryland National Capital Park and Planning Commission has prepared "A Manual on Storm Water Management" which was published in June, 1974.

(7) Control of erosion on-site during and after construction should be a requirement.

This is required under Maryland Law which places responsibility for approval of plan and enforcement on local Soil Conservation Districts. Fairfax County also requires erosion control and Virginia has legislation similar to Fairfax County. The District of Columbia does not have legislation requiring sediment control.

(8) The most advanced hydrologic techniques should be used in computation and solution of SWM problems. Computer models to compute hydrographs and evaluate effect of storage are available and ought to be used where feasible. They are becoming an almost indispensable tool to analyse alternate systems of storm water management including all costs provided enough basic data is available. Simplified models can be used at the planning level.

(9) A program of measurement of stream flow and rainfall on small watersheds both undeveloped and developed can be of great value in calibrating and verifying output of computer models.

Fairfax County has had a rather extensive program in cooperation with the USGS. In Montgomery County a more limited program has been conducted by the USGS.

(10) The design of street drainage must be coordinated with the storm water system giving consideration to traffic densities and relative requirements during storm periods. Careful attention should be given to capacity and placement of storm drain inlets so as to utilize the capacity of the underground pipes fully for minor storms; the values of the underground system is partially lost if the water is not intercepted by the inlets. Under major storm conditions the movement of emergency vehicles should not be seriously impeded.

(11) Provision should be made for maintenance of all components of the storm water system, clearly defining responsibilities and allocating funds, establishing procedures for maintenance and means for enforcement.

(12) Recharge of ground water aquifers should be included in the storm water system where conditions are favorable. This results not only in conservation of a valuable resource, water, but also in reducing both peak and volume of runoff. The cost effectiveness of such measures and possibility of contamination of ground water should be carefully studied. On a lesser scale use of broad vegetated channels to increase infiltration should be encouraged where the soil profile is suitable. On tight soils grass channels should have adequate slope to drain freely.

(13) There is a growing awareness that treatment of storm water to remove excessive pollutants may become a requirement in the future. Storm water management planning should take cognizance of the dual use that may be made of impoundment facilities as a detention/retention structure and sedimentation basin.

A water quality sampling program for all the watersheds in the county has been undertaken by the Montgomery County Department of Environmental Protection. They have required feasibility studies for water quality as a part of the design studies for impoundments funded by the departments.

(14) A regular program of street cleaning should be instituted as one of the effective methods of reducing pollution contributed to streams.

(15) The use of sediment traps in inlet boxes is not recommended. They are ineffective and generate excessive maintenance costs (this does not apply to combined sewerage systems).

IV. SURVEY MATRIX

The Storm Water Management (SWM) Task Force decided the best vehicle for achieving its first objective, determining extent of existing plans and programs for SWM, would be in the form of a questionnaire distributed to various Washington Metropolitan Area public agencies. During the formation and refinement of this questionnaire, two distinct sections developed. The first and probably most important section concerned generalities, i.e., definitions, objectives, degree of involvement, regulations and policies. The second section objective was to compile design criteria for both storm drainage and SWM. (See sample questionnaire at Appendix A). Completion of the questionnaire generally followed the same procedure beginning with interviewing public agency officials in policy making positions followed by procurement of design criteria and other pertinent data.

The following local, state and federal agencies cooperated and completed the questionnaire:

Maryland

Prince George's County Department of Public Works

Montgomery County Department of Environmental Protection

Maryland-National Capital Park and Planning Commission - Montgomery and Prince George's Counties

Washington Suburban Sanitary Commission

Department of Natural Resources - Water Resources Administration

U. S. Soil Conservation Service - Prince George's and Montgomery Counties

U. S. Soil Conservation Service - College Park Headquarters

Virginia

City of Alexandria

Fairfax County Department of Public Works

City of Fairfax

City of Alexandria Department of Transportation and Environmental Services

Other

Metropolitan Washington Council of Governments, District of Columbia

Results of our questionnaire, tabulated for ready reference, are shown on pages 12-20 inclusive. They indicate a wide range of opinions concerning definitions, goals of SWM, etc., but also indicate some common trends. Several localities such as Fairfax and Montgomery Counties are totally committed to SWM, while Prince George's County is undecided and the District of Columbia has no ongoing studies. The large amount of public funds involved was surprising and Fairfax County headed the list. To date, the majority of funds have been expended for various studies. However, Montgomery County's projected budget indicates much larger allocations for construction in the coming years. The magnitude of present and proposed public agency's spending would indicate a commitment to achieve some form of SWM in their respective locality. One common difficulty voiced by almost all was development of a satisfactory maintenance arrangement for SWM devices. Questions concerned personnel allocations and budgeting required for maintenance.

Detailed responses to the questionnaire are included at Appendix B.

General Questions	MARYLAND			
	Prince George's County Dept. of Public Works	Montgomery County Dept. of Env. Protection	M-NCPPC-P. G. Co. Env. Pl. Division	Dept. of Nat. Resources Water Resources Administration
1. What would be your definition of Storm Water Management (SWM)? What are your goals?	The total of all measures taken to regulate storm-generated runoffs & stream flows to reduce adverse environmental & economic imacts.	The handling of run-off as to protect the stream environment. Protect water quality by run-off retention	Systems analysis of hydrologic phenomena. Protect life, property and aesthetics	Get involved thru sediment control program. Devices necessary to prevent offsite stream bank erosion/protect integrity of natural streams systems/could include desire to minimize flood peaks/officially-prevent offsite erosic
2. What SWM Programs are you engaged in now? How much is your budget for SWM Programs?	Principal activity involves review of capital projects to take advantage of on stream mgmt to reduce down stream flood peaks. $10,000 Yr.	Watershed studies, watershed systems plans & design, study improvements of streams in developed areas, evaluate land use changes, appraise on site program.	Anacostia watershed model Piscataway & Mattawoman investigation; C of E reports. Local reviews. Lake site studies. $35,000/Yr PGC for Yr. '74	Money from Agnes funds/con sultant assisting in developin SWM manual/Committee advising on SWM/involved with Anacostia River Basin Study/ Owens Falls & Herring Run studies/Collington Branch Study/$130M/yr Fed & State Funds.
3. In your budget, what are the proportions for (a) SWM study, (b) review & processing plans, (c) enforcement, and (d) construction. Would you like to see these proportions changed? Why?	SWM Study 50% Review of Plans 50%	F.Y. Adm. Study. Constr. 74 57 410 281 75 60 445 1129 76 60 510 2603 (thousands of dollars)	Anacostia SWM Study 28% Review and Processing 3%	Not involved in enforcement & construction at present time/most funds are in studies/time will change proportions
4. Do you recognize any weakness in your program?	Lack of a defined role for various agencies	Maintenance not assured & discrepancy between the 2 year on-site SWM criteria & the 10 year drainage design storms	Lack of money and staff. Lack of county commitment. Misunderstanding of SWM program. Model not yet evaluated.	Can not move as fast as would like to/knowledge is developing with studies/ insufficient political interest.
5. Are you generally satisfied with the current SWM techniques? Would you like to see any change? In what way?	Analysis methods prescribed are inadequate & produce badly sited, poorly performing, unattractive facilities.	Land use changes need to be evaluated in terms of the effect on total stream valley system	No/right direction/looking at regional approach	No - thats why manual is being developed/need to get away from a "design" storm
6. Do you have any SWM criteria? (Obtain copy) Are there any other gencies involved in your programs?	The only published criteria is that of the M-NCPPC which is regarded as incomplete. The draft criteria of the Md. W.R.A. is an improvement.	June 1971, Mont. Co. S.C. Dist. interim criteria. Yes, the M-NCPPC, MCSCD, Dept. of Trans. & Md. WRA	Yes. WRA involved	Not at present - manual is being developed
7. What kind of financial arrangements would be equitable to public and private interests for implementing your SWM programs?	Most of the SWM activities should be financed through general tax revenue as at present	Currently under study	Blanket requirement for everyone to be involved	Fair for private to pay for sediment control - unfair relation to flood control.
8. What arrangements are there for maintenance or modification of SWM structures?	On the basis of nuisance and complaints maintenance occurs	SWM structures put in public easements	County assigns responsibilities.	Private finances - public maintenance
9. What are your policies relative to flood plains?	Private developers are barred from placing structures in the fifty year flood plain	Building restriction line 25' from 50 yr. flood plain	Flood plain is where water reaches, not just an elevation. Opposed to flood plain filling and diminishing.	Would prefer no encroachment in flood plan/facing lega problems in this area/public ownership of flood plains would probably be best/flood plain based on 50 year storm

	MARYLAND				
	M-NCPPC Env. Pln. Div. Mont. Co.	WSSC	Montgomery County Soil Conservation District	U.S. Soil Conservation Service, Hdqrs. - College Park	Prince George's County Soil Conservation District
1.	Protection of life & property Control of erosion preservation & enhancement of environment.	Prevention of property damage & offsetting increased runoffs. SWM policy being developed	Prevention of flooding, bank erosion & provisions for ground water recharge	Prevention of increased runoff due to urbanization is the basic philosophy	Control at point of precipitation, and protection of receiving streams are primary philosphies
2.	Development of a comprehensive Storm Water Management Plan. $190,000 budgeted for the study. Seneca & Muddy Basins	Committee established to develop a program. Flood control studies underway $20,000/Yr.	Review of SWM plans and act as consultant to the S.C.I District $12,000/Yr.	Principal activity is technical support to soil conservation districts	Principal activity is review of ponds and P.L.566 program
3.	Development of SWM plan and policies $190,000 Inventories - 3000	Not available	Plan review 60% Field charges 12%	Not involved in enforcement or inspection	Reviews of plans 100%
4.	Lack clear cut responsibility definition & lack of staff	Initial weakness is large number of agencies involved. May be a later strength	Guidelines to implement general criteria are needed. Fewer, larger SWM structures & better enforcement needed	Lack of enforcement and inspection	Shortage of technical staff and lack of enforcement and inspection arrangements.
5.	Replacement of recharge areas needed. Evaluation of social & physical damages - level of erosion control.	No.	The watershed approach & techniques geared to particular problems & areas are needed	Criteria, procedures, and construction are inadequate	No
6.	Yes MSCD	No firm criteria	Yes, the 1971 Mont. Co. SC Dist. interim criteria. Yes, the M-NCPPC, DEP & the Mont. Co. Dept. of Trans.	Have no criteria	No
7.	N/A	Under study	Special drainage districts	Refer to local agencies	Would prefer the developer pay a fee rather than designing his own on-site ponds
8.	Some structures in park areas maintained by M-NCP NCPPC Park Dept.	Maintenance bond held on structures in public R.O.W.	No way to currently require maintenance	A statement on who is responsible for maintenance required in Mont. Co.	Applicant should be responsible for maintenance
9.	Building lines must be 25' from 50 yr flood plain on ultimate development computation. This policy may be revised to 100 yr flood plain.	Keep development out of the 50 year flood plain	Delineated by Md. WRA & local jurisdiction. Floodways should be differentiated from flood plains	Flood plains should remain in natural condition for ecological, aesthetic & hydraulic reasons	50 Year storm used as basis

		VIRGINIA		WASHINGTON, D.C.	
	Fairfax County	Fairfax City	Alexandria	COG	District of Columbia
1.	Use prior to run-off Develop a plan that implements that definition	A plan with implementation for solving problems	Controlling storm runoffs & stream flows to reduce downstream erosion problems, reduce capital cost of drainage system, & eliminate flooding & environmental problems.	Attain recognition of storm water pollution in programs designed to improve stream water quality	No involvement
2.	A county-wide drainage plan that considers storm water a resource $11,000,000 bond	Storm water detention Stream clean and realignment $25,000 /Yr.	Watershed studies, detention/retention design; Op. Budget $125,000/Yr. Capital Budget $3MM/Yr.	A computer programming model to predict the effects of SW on water quality in the Potomac Estuary $40,000	
3.	SWM Study $1.5 mil. Plan review and inspection charged to developer in a fee	All in construction. Need some in enforcement	Study 20% Review & Processing Plan 20% Enforcement 5% Construction 55%	All in SWM study. No change desired	
4.	1977 completion of report is limiting	Yes	We don't know yet.	More knowledge of pollution loads due to storm water is required	
5.	Time will tell	Yes Enforcement needs improvement	We are still experiencing the SWM technique	No	
6.	Yes No	No	No,	No	
7.	County-wide pro rata sharing	No answer	N/A	Detention should be in a development cost	
8.	Owner agrees to maintain - if failure to occurs, county takes over & charges property	None, but bonding proposed	SWM structures placed in public R/W and easements.	N/A	
9.	USGS established flood plains in developing areas	Building permitted in flood plains if adequate drainage and flood free structures provided	Enforce Federal Flood Insurance Regulations.	Discourage development in them	

	Prince George's County Dept. of Public Works	Montgomery County Dept. of Env. Protection	M-NCPPC-P.G. Co. Env. Pl. Division	Dept. of Nat. Resources Water Resources Admins.
PRECIPITATION 1. How do you decide the design storm frequency and duration?	The 1964 WSSC method (basically the rational method). A 10-Yr. frequency is normal. Routing down on longer areas	10 yr storm used. Larger cross culverts designed for 50 yr storm. Basins designed to control two year storm with piped spillway of a 5 yr or 10 yr storm capacity	County & State Requirements	In process of determining these criteria. Max. use 100 yr. freq. storm
2. Do you consider the spatial as well as temporal variations of storm? How?	No	No	Yes, 9 gauge inputs	Yes, see U.S. SCS
3. Do you consider the effect of moving rainstorm? How?	See WSSC	No	No. (See Type II Curve, SCS-TP-149)	No
4. What precipitation data do you use?	See WSSC	U.S. Weather Bureau data for Washington DC. 1899-1953 as shown in Technical Paper No. 25	Observed data for calibration of TP-40 predictions	U.S. Weather Bureau T.P.-40
5. Do you take infiltration into consideration?	See WSSC	Infiltration is accounted for only to the extent that it is reflected in the coefficient of runoff in the Rational Formula or other standard methods used.	Yes, as part of initial abstraction	Yes - See U.S. Soil Conservation Service
RUN-OFF 1. What method (or formula) do you use to compute peak run-off?	See WSSC	The Rational Formula is used for pipe systems & small watersheds. A comparison of results of several other methods is used on the larger watersheds	SCS hydrograph method	See U.S. - SCS Method
2. What are the parameters involved in the method you used? How do you determine these parameters?	See WSSC	The parameter used & the range of values accepted are spelled out in the Storm Drainage Criteria	See references	See U.S. - SCS Method
3. How do you determine the time of concentration?	See WSSC	Standard values for type of land use (or zoning) are given in the criteria	Function of lag time, peak time, and duration	See U.S. - SCS Method
4. How do you determine total volume of run-off and its time distribution?	See WSSC	This is not ormally done on the average storm drainage system	An automatic output	See U.S. - SCS Method

	M-NCPPC Env. Pln. Div. Mont. Co.	WSSC	Montgomery County Soil Conservation District	U.S. Soil Conservation Service Hdqrs.-College Park, Md.	Prince George's County Soil Conservation District
1.	100 yr runoff frequency. 606 person type III for flood plains 2yr for sediment control	Frequency: Degree of protection deemed appropriate. 10 yr. for pipe system. Duration: Time of concentration.	Essentially the same as US. SCS	Design Storm frequency is spelled out in State & Soil Cons. Dist. criteria for permanent structures. SWM criteria is 2 or 10 yr storm Duration explained in SCS. TP-149.	Essentially the same as USSCS
2.	Yes. Actual rainfall event is simulated.	No	Essentially the same as US. SCS	For all practical purposes, no, on these watersheds that are generally small.	Essentially the same as USSCS
3.	No	No	Essentially the same as US. SCS	No.	Essentially the same as USSCS
4.	Actual recorded precipitation	Weather Bureau Technical Paper #25	Essentially the same as US. SCS	U.S. Weather Bureau TP-40	Essentially the same as USSCS
5.	Yes. Hydrocom model is a continuous model giving water sequence at all times.	No	Essentially the same as US. SCS	Yes. SCS runoff curve number method is based on infiltration rates for 4 different soil permeabilities, as well as the impervious condition.	Essentially the same as USSCS
RUN-OFF 1.	Model	Rational	Essentially the same as US. SCS	The SCS runoff curve number method.	Essentially the same as USSCS
2.	All parameters in the hydrological cycle.	Runoff - ultimate land use Intensity- 1 and 4 above Area - land contours	Essentially the same as US. SCS	Soil & soil cover, watershed shape factor, antecedent moisture condition, 24 hr rainfall, watershed slope, storage, hydraulic characteristics of channel(s), drainage area.	Essentially the same as USSCS
3.	Not applicable	Overload flow plus time in system. Time to 1st inlet-coming residential, 5 mins. commercial.	Essentially the same as US. SCS	Runoff curve number method automatically considers time of concentration as explained in SCS-TP-149 & designer need not make a computation of T.C.	Essentially the same as USSCS
4.	Not applicable	Duration x intensity	Essentially the same as US. SCS	SCS only method aware of that spec. designed to determine runoff thru curve numbers. Time dist. done by hydrograph methods incl. off-shot from that. (the "SCS Tabular" method.	Essentially the same as USSCS

Precip.	Fairfax County	Fairfax City	Alexandria	COG	District of Columbia
1.	10 yr. storm flood plains on 100 yr. storm. SW detention on 10 year but those structures out of 100 year flood plain	See Fairfax County	10 yrs. for storm sewers 25-50 yrs. for channels 50-100 yrs. for culverts	The 8 per year storm for pollution studies	The 15 year design frequency is used for storm design
2.	No	No	No	No	No.
3.	No	No	No	No	No
4.	U.S. Weather Bureau	See Fairfax County	National Airport	Weather Office tapes	U.S.W.B. 1894-1954
5.	No	Yes, in determining run-off factors and SW detention	Yes, in runoff coefficient	Very crudely - imperviousness ratings are assigned to various land uses	No
RUN-OFF 1.	Up to 200A-rational method 200A+ - Anderson formula	Rational	Rational Method	The EPA SWM Model is used	Rational
2.	See references	Time of concentration and frequencies	C I A	The EPA SWM Model is used	The land use predicted for the year 2000 determines the coefficient of run-off
3.	Commercial - 5 mins. Townhouse - 5-10 mins. Commercial - 10-15 mins.	Slope and ground cover	10 min. but empirically calc for large areas	The EPA SWM Model is used	10 minutes plus time of flow in the sewer from the most remote inlet to point considered
4.	Hydrographs	Hydrographs	Main Q plus tributory Q's for that time distribution	The EPA SWM Model is used	Not generally computed

RUNOFF (Cont.)	Prince George's County Dept. of Public Works	Montgomery County Dept. of Env. Protection	Department of Natural Resources	M-NCPPC P.G. Co. Env. Pln. Div.
5. Do you generally route flood flow through the drainage system? If you do, what method?	See WSSC	The SCS tabular method of flood routing is used analyzing some of the larger systems.		Convex Routing Method and Storage Indication Method
6. Are you aware of any storm run-off computer models that are available now? Do you use them to compute storm run-off?	See WSSC	"Montgomery County Storm Evaluation Model" (MOSEM) Watts Branch, Crabbs Branch Turkey Branch, Upper Sligo watersheds.		See references
STORM DRAINAGE SYSTEM 1. Do you make decision on whether to use an open channel system of closed conduit system? If you do, on what basis?	See WSSC	Yes. Decision is generally made on basis of compatibility with surrounding development. As a rule when flow exceeds that handled by 72" pipe an open channel is used.	Not involved	Not involved
2. In computing flow through the drainage system, what formula do you use? How do you choose the resistance coefficient?	See WSSC	The rational formula is used. Coefficients are chosen from those specified in Interim Criteria	Not involved	Not involved
3. What type of materials do you usually recommend for construction of storm drainage system? On what basis do you make such recommendations?	See WSSC	Reinforced concrete culvert pipe normally used. If necessary to reduce velocity or provide necessary clearance, C-MP sometimes used.	Not involved	Not involved
4. If closed conduit system is used, how do you figure out the loadings on the conduit? Do you follow any specific criterion?	See WSSC	A standard loading table based on Marston formula is used.	Not involved	Not involved
5. Are there any specifications that you generally follow in design of appurtenances for storm drainage systems? If not, do you think it is desirable to have one?	See WSSC	WSSC Standard Structures are part of county road code. Md. State Highway Admin. Standards and specs also used.	Not involved	Not involved
6. In design of storm drainage systems, do you consider retention/detention facilities? Why? When? Where?	See WSSC	Detention facilities are designed in conjunction with parking facilities, etc. but not generally on county street projects.	Not involved	Not involved
7. Is a watershed approach made in evaluating a SWM project?	See WSSC	Dept. of EP, through data stored in its MOSEM program on Watts & Crabbs Branch, able to evaluate effect of specific SWM projects. Evaluation of alternate schemes of SWM in Seneca Basin being made by CH_2M Hill for M-NCP&PC	Not involved	Not involved

	M-NCPPC Env. Pln. Div. Mont. Co.	WSSC	Montgomery County Soil Conservation District	U.S. SCS Hdqrs - College Park, Md.	Prince George's County Soil Conservation District
5.	Yes Model	No		SCS method	
6.	Yes	Yes No- we are in process of acquiring computer capability		Yes. SCS has 2, a simplified model & a rather sophisticated model. Yes, but I seldom need to on type of work I do now.	
STORM DRAINAGE SYSTEM 1.	Not involved	Yes Economics compatibility with surroundings maintenance requirements.	Not involved	Not involved	Not involved
2.	Not involved	Manning's We use widely accepted coefficients based on material of lining.	Not involved	Not involved	Not involved
3.	Not involved	Reinforced concrete except on large streams (earth) Basis: serviceability	Not involved	Not involved	Not involved
4.	Not involved	Basically, CPA recommendations.	Not involved	Not involved	Not involved
5.	Not involved	We have our own criteria and standards which have been developed over the years.	Not involved	Not involved	Not involved
6.	Not involved	Yes, to offset increased run-off due to development; when it is desirable to protect the downstream reach or when it is necessary to prevent a problem from arising or not to aggrevate an existing problem	Not involved	Not involved	Not involved
7.	Not involved	Yes, though very limited as we do not have watershed studies yet.	Not involved	Not involved	Not involved

	Fairfax County	Fairfax City	Alexandria	COG	District of Columbia
5.	Yes	No	No	The EPA SWM Model is Used.	
6.	No, but under study	No	Yes No	The EPA SWM Model is used.	Preliminary studies of models have been covered out
1.	Open where possible	Economic appearance & flow	Yes Dependent upon area	N/A	Local conditions dictate choice
2.	Manning formula n. Mat'l 0.013 conc. pipe .015 conc. ditches .03 Hand spaced rip rap .035 Dumped rip rap	Manning formula	Manning formula	N/A	Manning formula PCR
3.	RCP, RC culverts, rip rap & grass lined ditches. CMP for some culverts	Concrete, transile, coated steel galvanized and aluminum	Concrete	N/A	PCP for 78" & less. Flow characteristics, life expectancies, resistance to scouring, ease of handling, strength, joints, cost, availability & eas of installation impact the recommendation
4.	Va. Dept. of Highways for conduit loads	No	Marston theory & Boussinesq solution of stress distribution	N/A	Loading conditions, conduit material, shape, rigidity are among the factors considered. ASCE Manual No. 37 and texts
5.	VDH	Fairfax County and Virginia Department of Highways	Yes, City of Alexandria Standard Specification for Construction	N/A	The DES design manual is used
6.	Detention nearly universally	1. Reduce further overloading to system 2. New development 3. Throughout the City	Yes, when natural stream would be over-loaded	For treatment simulations only	
7.	Yes	No	Yes	Yes	Yes, in order to prevent a piecemeal approach to drainage construction

APPENDIX A

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) What would be your definition of Storm Water Management (SWM)? What are your goals?

(1, 2, 0) What SWM Programs are you engaged in now? How much is your budget for SWM Programs?

(1, 3, 0) In your budget, what are the proportions for (a) SWM study, (b) review and process plans, (c) enforcement, and (d) construction. Would you like to see these proportions changed? Why?

(1, 4, 0) Do you recognize any weekness in your program?

(1, 5, 0) Are you generally satisfied with the current SWM techniques? Would you like to see any change? In what way?

(1, 6, 0) Do you have any SWM criteria? (Obtain copy) Are there any other agencies involved in your programs?

(1, 7, 0) What kind of financial arrangements would be equitable to public and private interests for implementing your SWM programs?

(1, 8, 0) What arrangements are there for maintenance or modification of SWM structures?

(1, 9, 0) What are your policies relative to flood plains?

(2, 0, 0) Questionnaire on Design Review

(2, 1, 0) PRECIPITATION

(2, 1, 1) How do you decide the design storm frequency and duration?

(2, 1, 2) Do you consider the spatial as well as temporal variations of storm? How?

(2, 1, 3) Do you consider the effect of moving rainstorm? How?

(2, 1, 4) What precipitation data do you use?

(2, 1, 5) Do you take infiltration into consideration? How?

(2, 2, 0) RUN-OFF

(2, 2, 1) What method (or formula) do you use to compute peak run-off?

(2, 2, 2) What are the parameters involved in the method you used? How do you determine these parameters?

(2, 2, 3) How do you determine the time of concentration?

(2, 2, 4) How do you determine total volume of run-off and its time distribution?

(2, 2, 5) Do you generally route flood flow through the drainage system? If you do, what method?

(2, 2, 6) Are you aware of any storm run-off computer models that are available now? Do you use them to compute storm run-off?

(2, 3, 0) STORM DRAINAGE SYSTEM

(2, 3, 1) Do you make decision on whether to use an open channel system or closed conduit system? If you do, on what basis?

(2, 3, 2) In computing flow through the drainage system, what formula do you use? How do you choose the resistance coefficient?

(2, 3, 3) What type of materials do you usually recommend for construction of storm drainage system? On what basis do you make such recommendations?

(2, 3, 4) If closed conduit system is used, how do you figure out the loadings on the conduit? Do you follow any specific criterion?

(2, 3, 5) Are there any specifications that you generally follow in design of appurtenances for storm drainage system? If not, do you think it is desirable to have one?

(2, 3, 6) In design of storm drainage systems, do you consider retention/detention facilities? Why? When? Where?

(2, 3, 7) Is a watershed approach made in evaluating a SWM project?

APPENDIX B

AGENCY/JURISDICTION: Soil Conservation Service -
College Park, Maryland
PERSON INTERVIEWED/RESPONDED: Mr. Mark Boysen
INTERVIEWING/CORRESPONDING TF MEMBER(S): J. Morris, D. Chapman
DATE: May 2, 1974 (INTERVIEW)

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) Preventing increases in runoff as a result of urbanization of watershed / Do not consider flood control within the definition of Storm Water Management / got involved under state sediment control laws

(1, 2, 0) Technical support to soil conservation districts / Montgomery County has a firm policy / Anne Arundel County now has firm policy

Budget - no feel for figures at present / will respond later

(1, 3, 0) Do not get involved in either enforcement or construction

(1, 4, 0) Lack of enforcement and inspection at local level / lack of consistent criteria / do not really have program of own / establishment of policy has been difficult / shortage of personnel

(1, 5, 0) Satisfied with devices and methods / dissatisfied with criteria and procedures / unhappy with application of devices / poor construction / would like better construction

(1, 6, 0) Do not have criteria / provide expertise for others to develop criteria

(1, 7, 0) Refer to local agencies

(1, 8, 0) In Montgomery County, require statement as to who will maintain

(1, 9, 0) Flood plains should remain in mutual conditions for three reasons;
1. ecological; 2. aesthetic; 3. hydraulic

AGENCY/JURISDICTION: Soil Conservation Service,
College Park, Maryland
PERSON INTERVIEWED/RESPONDED: S. M. Boysen
INTERVIEWING/ CORRESPONDING TF MEMBER(S): W. R. Elliott
DATE: June 7, 1975 (LETTER)

(2,0,0) Questionnaire on Design Review

(2,1,0) PRECIPITATION

(2,1,1) The design storm frequency is spelled out in State & Soil Conservation District criteria for permanent structures. SWM criteria is the 2 or 10 year (generally, and soon completely; the 10 year storm). Duration is handled within the runoff computation procedure as explained in SCS-TP-149.

(2,1,2) For all practical purposes, no, on these watersheds that are generally small.

(2,1,3) No

(2,1,4) U. S. Weather Bureau TP-40

(2,1,5) Yes. The SCS runoff curve number method is based on infiltration rates for four different soil permeabilities, as well as the impervious conditions.

(2,2,0) RUN-OFF

(2,2,1) The SCS runoff curve number method.

(2,2,2) Soil and soil cover, watershed shape factor, antecedent moisture condition, 24 hour rainfall, watershed slope, watershed storage, hydraulic characteristics of channel(s), drainage area.

(2,2,3) The runoff curve number method automatically considers time of concentration as explained in SCS-TP-149, and the designer need not make a computation of Tc.

(2,2,4) The SCS method is the only method I am aware of that is specifically designed to determine runoff, through the runoff curve numbers. Time distribution is done by well accepted hydrograph methods, including an off-shot from that, the "SCS tabular" method.

(2,2,5) The SCS method (see SCS-TP-149) itself routes storms through drainage systems. This is one of the bid differences between SCS and other procedures. For non-homogeneous watersheds, the tabular method is designed to determine hydrographs of homogeneous subareas and route these hydrographs through stream reaches to a downstream design point.

(2,2,6) Yes, SCS has two, a simplified model and a rather sophisticated model. Yet, but I selmod need to on the type of work I do now.

(2,3,0) STORM DRAINAGE SYSTEM

(2,3,1) Not involved

(2,3,2) Not involved

(2,3,3,) Not involved

(2,3,4) Not involved

(2,3,5) Not involved

(2,3,6) Not involved

(2,3,7) Not involved

AGENCY/JURISDICTION: Soil Conservation Service - Prince George's County
PERSON INTERVIEWED/RESPONDED: Mr. Jack Stillwell
INTERVIEWING/CORRESPONDING TF MEMBER(S): W. Caruthers, J. Morris, D. Chapman
DATE: April 11, 1974 (INTERVIEW)

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) Basic Philosophy is to control raindrop where it falls / want runoff to be what it was prior to development / Do not consider S.W.M. flood control / Feel primary purpose is to protect receiving streams from excessive velocities and erosion for 10 year storm /

(1, 2, 0) Reviewing any ponds / Public Law 566 Flood Control Programs

Piscataway - approved for planning
Matawoman - priority of Preliminary Investigations Report
Western Branch - District has made formal request for Preliminary investigations

(1, 3, 0) 25% of staff time used in review and processing / staff cost $10,000/year / 15-20 ponds a year / figure on PL566 projects can be obtained from state administration office / no responsibility for construction and enforcement

(1, 4, 0) Need technical staff help / presently, no arrangements for enforcement and inspection

(1, 5, 0) No / Needs studies /

(1, 6, 0) No - see MNCPPC

(1, 7, 0) Would prefer to have developer pay fees in lieu of designing and building on site ponds

(1, 8, 0) Favor making applicant totally responsible for maintenance

(1, 9, 0) / Same as state - 50 year storm / would like 100 year storm protection / Flood plain integrity-save in natural state /

AGENCY/JURISDICTION: Maryland Water Resources Administration
PERSON INTERVIEWED/RESPONDED: Mr. Bob Norton
INTERVIEWING/CORRESPONDING TF MEMBER(S): W. Caruthers, D. Chapman
J. Morris

DATE: April 25, 1974 (INTERVIEW)

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) / Get involved thru sediment control program / Devices necessary to prevent offsite stream bank erosion / protect integrity of natural streams systems / could include desire to minimize flood peaks / officially - prevent offsite erosion /

(1, 2, 0) Money from Agnes funds / consultant assisting in developing a Storm Water Management manual / Committee advising on Storm Water Management / involved with Anacosita River Basin study / Owens Falls and Herring Run studies / Collington Branch Study / $130,000 per year Federal and State Funds

(1, 3, 0) Not involved in enforcement and construction at present time / most funds are in studies / time will change proportions

(1, 4, 0) Cannot move as fast as would like to / knowledge is developing with studies / insufficient political interest

(1, 5, 0) No - thats why manual is being developed / need to get away from a "design" storm

(1, 6, 0) Not at present - manual is being developed

(1, 7, 0) Fair for private to pay for sediment control - unfair relation to flood control

(1, 8, 0) Private finance - public maintenance

(1, 9, 0) Would prefer no encroachment in flood plain / facing legal problems in this area / public ownership of flood plains would probably be best / flood plain based on 50 year storm

AGENCY/JURISDICTION: U. S. Soil Conservation Service, Rockville, Maryland
PERSON INTERVIEWED/RESPONDED: Mr. George Stem
INTERVIEWING/CORRESPONDING TF MEMBER(S): W. Petzold
DATE: June 20, 1974

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) Definition of SWM - Not specifically defined by Mr. Stem.

Goals - PL 566 objectives taken to the local level. SWM should provide a certain level of protection from flooding, bank and stream erosion, provide for ground water re-charge.

(1, 2, 0) Storm Water Management Programs

The Soil Conservation Service, as the technical staff for the Montgomery County Soil Conservation District, reviews on-site SWM as part of the sediment control plan. The SCS also provides design assistance in SWM. The SCS role is not to do SWM studies but to provide consultative input as requested. SCS has been involved in providing design data on existing SWM structures and field evaluation for the Park and Planning Commission consultant in the Muddy Branch and Seneca Creek watershed studies. Cost data on SWM was compiled for the Anacostia Basin study. A PL 566 study was made by the SCS for the Seneca Creek basin.

(1, 3, 0) Budget for SWM

Approximately 60% of the staff time is spent for plan processing and review. About one-third of that time is spent on SWM. Roughly 12% of staff time is spent on evaluating revisions to the original plans due to changed field conditions, non-conformance by developers or inadequate design. It is estimated that $12,000 per year could be considered as a budget figure for SWM (mostly in the review and processing of plans). Mr. Stem would like to see more time spent in evaluation and monitoring of the existing storm water management structures and in program development.

(1, 4, 0) Mr. Stem believes that the 1971 SWM policy and criteria of the MSCD needs thorough evaluation as it relates to a watershed approach. He sees a need for better guidelines and standards to supplement the policies and criteria already in effect. He questions the emphasis on controlling the two-year design storm. The on-site program requires many minor structures that take up a disproportionate amount of time and money. Mr. Stem would like to see fewer and larger SWM structures. Better tools for enforcement are needed. Perhaps bonding to assure that SWM structures are built should be required.

(1, 5, 0) Mr. Stem sees the need for a watershed approach that would relate land treatment, water resource management, and water pollutant control. Techniques geared to the particular problems and size of a drainage area would be a desirable change.

(1, 6, 0) SWM Criteria

The Montgomery Soil Conservation District adopted interim criteria for storm water management in June, 1971. The MSCD has statuatory authority under state legislation for approval of all plans for an earth change. They are involved in an advisory capacity at the Subdivision Review Committee meeting at the Park and Planning Commission at which time a conceptual plan for sediment control and storm water management is reviewed. At the present time they provide the technical review for the SWM plans with processing and enforcement handled by the Sediment Control Section of the Department of Environmental Protection. The Montgomery County Department of Transportation approves the plans for the storm drainage system in new subdivisions.

(1, 7, 0) Financing of SWM

Mr. Stem favors special drainage districts that would include assessments for storm water management. Proposed developments would pay a fee that would cover the design, installation and maintenance of off-site storm water management.

(1, 8, 0) Maintenance is a basic weakness of the SWM program in Montgomery County. The records of existing structures are inadequate and there is currently no way to require maintenance. Easements or covenants for maintenance should be required.

(1, 9, 0) Flood Plains

The State Water Resources Administration protects the 50 year flood plain encroachments under existing regulations for areas with over 400 acres of watershed area. The local jurisdictions have control in the lesser areas. Subdivision regulations set up a building restriction line 25 feet from the 50 year flood plain (calculated for future development). Floodways should be differentiated from flood plains and should be delineated even in those areas where piped systems have replaced natural drainage. This would provide for the safe passage of water even when the design storm is exceeded.

AGENCY/JURISDICTION: The Maryland-National Capital Park and Planning Commission
PERSON INTERVIEWED/RESPONSED: Jorge A. Valladares
INTERVIEWING/CORRESPONDING TF MEMBER(S): William Caruthers
DATE: April 25, 1974 (Letter)

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) a) Prince George's - MNCPPC
Storm Water Management Goal and Objectives,
Staff Working paper (question 1)

b) PGCPB No. 74-18 Resolution

c) SWM Criteria, January 30, 1974 (question 6)

d) SWM Check List

e) "A Comprehensive Storm Water Management Program"

(1, 2, 0) a) Anacostia watershed modeling

b) Piscataway and Mattawoman watershed investigation (S.C.S. - PL 566 program)

c) Corps of Engineers - floodplain information reports

d) Local "on-site" subdivision review. Site plan review

e) Assorted lake site studies

Current SWM programs are budgeted for approximately $35,000 for FY 1973-1974, P.G. County only.

(1, 3, 0) a) Anacostia SWM study = 28%

b) Review and processing = 3%

c) and d) Zero %

The proportions will change for review and processing if "on-site" control becomes mandatory. Proportion spent on modeling could increase if County wants to speed up the program.

(1, 4, 0)
- Insufficient staff and money
- Lack of County commitment to program at this point in time

- General misunderstanding of the SWM program
- Model output yet to be evaluated

(1, 5, 0) Not satisfied. Too much, if not all, codes and regulations geared to corrective as opposed to preventive measures. Emphasis to date has been to remove excess water off property as quickly as possible with little regard for down and upstream effects.

(1, 6, 0) Other agencies in our SWM program include the State Water Resources Administration.

(1, 7, 0) We would like to see blanket coverage with fee-in-lieu for those unable to provide control "on-site". Public agencies would be fee exempt.

(1, 8, 0) Our position is to rely on the County to assign these responsibilities to current operating agencies.

(1, 9, 0) In general, we oppose structures within the floodplain, particularly residential units. We are opposed to floodplain filling and other measures that tend to diminish the area for natural storm water storage. We favor retention of streams and floodways in their "natural" state. Through our park acquisition program we will continue our program of floodplain purchase. Floodplain usage for parking, ball fields, etc. is acceptable.

(2, 0, 0) Questionnaire on Design Review

(2, 1, 0) PRECIPITATION

(2, 1, 1) Storm frequency is chosen with considerations to the County and State requirements and regulations of the floodplain.

(2, 1, 2) Consideration is given to both space and time. The hydrograph model which we are using accepts data from as many as nine pages. With respect to time, recording gages give the time distribution of rainfall. When using non-recording gages or synthetic data, Type II Curve from the SCS-TP-149 is used to simulate time distribution.

(2, 1, 3) Not explicitly. The effects of moving storm may have been considered but only to the extent such effects are reflected in the standard Type II Curve.

(2, 1, 4) We use observed data for calibration and standard storms from TP-40 for prediction.

(2, 1, 5) We consider infiltration as part of initial abstractions. We consider this approach sound because consideration is given to type of soil, type and density of vegetation, land use, and antecedent moisture condition.

(2, 2, 0) RUN-OFF

(2, 2, 1) We use the SCS hydrograph method.

(2, 2, 2) This question cannot be answered briefly. Instead, refer to Figure 2 in "Storm Water Management Study, Northeast - Northwest Branches, Anacostia River Basin," Technical Progress Report #2, M-NCPPC by J. O. Duru, 1973. The referenced figure will give you the parameters considered. As to how the parameters were determined, you will need to read the entire report.

(2, 2, 3) The time of concentration is determined as a function of lag time, peak time, and duration of excess rainfall.

(2, 2, 4) This is determined automatically because the method we use produces the entire hydrograph and not just the peak.

(2, 2, 5) We use the Convex Routing Method for the stream reaches and the Storage Indication Method in cases where a constriction (a bridge or culvert) causes ponding.

(2, 2, 6) Yes. Please refer to "Storm Water Management Study, Northeast - Northwest Branches, Anacostia River Basin, M-NCPPC Technical Report #1 -- Selection of a Runoff Model, by J. O. Duru, 1974.

AGENCY/JURISDICTION: Prince George's County
Department of Public Works
PERSON INTERVIEWED/RESPONDED: D. G. Chapman
INTERVIEWING/CORRESPONDING TF MEMBER(S): William Caruthers
DATE: June 5, 1975 (LETTER)

(1,0,0) Questionnaire for Public Agencies

(1,1,0) Definition of SWM: The total of all measures taken to regulate storm-generated runoffs and stream flows to reduce adverse environmental and economic impacts. The scope includes both erosion prevention and flood damage prevention, and involves effects of both the small, frequent events and the major, rare ones. Our goal is to minimize the total system costs, considering capital costs as well as long term costs such as maintenanct and environmental and community values. In the present economic situation, emphasis is on the capital cost.

(1,2,0) Current SWM Programs: Review of capital projects in DPWT program, mainly highways, to take advantage of opportunities for flood detention to reduce project costs, or alleviate known downstream flooding or erosion problems. Courtesy comments on SWM plans for private developments, upon referral by MNCP&PC or by the developer; comments on such plans and general County SWM planning through participation in the SWM Technical and Coordinative Review Committee. Official determination of flood plain studies submitted by developers. No identified budget, but we estimate staff time of about $10,000 per year on these activities.

(1,3,0) Proportions of SWM Expenditures: About half of the $10,000 is spent on SWM studies; the remainder on review of plans. We have no enforcement function other than normal contract inspection of street construction which includes conventional storm drains. Since SWM is generally included in construction only on the basis of cost saving, there is no net expenditure for construction. If DPWT is assigned a role in overall County planning, construction, or inspection and enforcement of SWM facilities, a substantial budget for this should be provided.

(1,4,0) Weaknesses in Program: The lack of a defined role for various agencies, and differing aims of the SWM program as seen by these agencies. Lack of an adequate program for enforcement of regulations restricting flood plain use, and for requiring SWM facility maintenance, especially on private property.

(1,5,0) Satisfaction with Techniques: Inadequate analysis methods are prescribed, sometimes resulting in badly sited or poorly performing installations. Available flood routing methods need to be more widely and thoroughly applied that is permitted under present criteria. Details of SWM structures need more careful design to improve long-range performance and maintainability. Hazards created under higher flows than designed for need more careful evaluation.

(1,6,0) SWM Criteria: County has not published any criteria; most plans have been based on MNCPPC criteria for on-site SWM. DPWT has distributed criteria for preparation of flood plain studies based on computing backwater curve for 50-year flood. Flood routing is not required but we urge this be done where storage is involved. In formulating future criteria we will draw heavily on the recently published Manual of SWM Practices fo the Maryland Water Resources Administration. Federal Flood Disaster Protection Act of 1973 will also be cited.

(1,7,0) Financing: Administrative activities of our present, limited program should continue to be funded by general tax revenue, e.g. the real estate tax. We would favor a runoff-related service charge on developed lands to finance public SWM construction or any major watershed studies for planning them.

(1,8,0) Maintenance of Modification: This is handled on a complaint basis generally, there being no regular SWM maintenance program. On-site probelems are referred to the Department of Licenses and Permits; complaints about the approved public drainage systems are referred to WSSC. There appears to be no agency charged with maintenance of drain systems not having approved status, nor for unimproved streams, however some of this is done by DPWT to protect roads.

(1,9,0) Flood Plain Policy: Building Code prohibits private developers from grading, filling, or placing structures in the 50-year flood plain except where for the benefit of general public; DPWT determines where flood plain limits are through review of developers' or available data. Revisions being drafted to comply with Federal Law (see 6) citing 100-year flood plain. All floors except non-residential basements must be 2 ft. above 50-year flood. Non-residential basements must be flood-proofed to this level. The revision would set these levels at the 100-year level without the 2-ft. freeboard. Modified flood plain limits resulting from WSSC approved construction may be used. Compliance with Maryland Water Resources Administration Regulations with permits where needed, is required. State permit referrals are reviewed for compliance with the Building Code.

(2,0,0) Questionnaire on Design Review

(2,1,0) PRECIPITATION

(2,1,1) Frequency and Duration: Design is based on the published WSSC criteria, since that agency by law approves all public drain construction. Latest criteria are dated 1964. Piped and channeled systems are required to be designed for 10-year storm of duration equal to the watershed time of concentration. For large waterways, where enclosure is unlikely, 25-year storm is used to size opening for trouble-free operation and the 50-year storm is checked to avoid road closing and to establish flood plain limits. Rational method is used up to about 400 acres, but any of several empirical formulas or flood routing may be used for larger watersheds, especially where storage is involved.

(2,1,2) Spatial Rainfall Patterns: These are not generally considered but are implied by some empirical formulae.

(2,1,3) Moving Rainfall Patterns: As above. However, on very large watersheds, where flood routing may be used, there is some possibility of considering storms moving in typical paths shown in Weather Bureau reports.

(2,1,4) Precipitation Data: As prescribed by WSSC graph for 10-year storm, uniform rate, based on Weather Bureau Technical Paper No. 25, for piped systems. Where flood routing is used, the 24-hour point rainfall distribution is uded and may be checked against shorter time distributions.

(2,1,5) Infiltration: This is considered minor in a properly built drain system and is ignored.

(2,2,0) RUNOFF

(2,2,1) Method for Peak Runoff: For piped systems, the Rational Formula is applied strictly according to WSSC criteria. For larger open watercourses over 400 acres, we favor the Fairfax County open file report by Daniel Anderson. Where storage is involved, the peak from flood routing may be used.

(2,2,2) Parameters: For Rational Formula, time of concentration is taken as the flow time based on average channel velocity plus a fixed collection time for first 400 feet overland. Runoff "C" factors are prescribed by WSSC criteria for various land use classifications, considering zoning and master plans. For other empirical formulea, the stream slope is also considered. For flood routing, we favor the SCS Engineering Field Manual approach deriving runoff curve numbers depending on soil type and land use. Flood plain cross sections are required for flood routing.

(2,2,3) Time of Concentration: As above. Where automatic flood plain routing is involved, we would adjust the time if inconsistent with the computed time to peak, and rerun.

(2,2,4) Total Volume: This is determined only where storage is involved using the unit hydrograph techniques of the SCS.

(2,2,5) Flood RoutingL This is not usually done except where storage is involved, rarely for piped of channeled systems. SCS methods are used as noted above, preferably by computer.

(2,2,6) Computer Models: SCS TR-20 and WSP2 are favored, however, we have not established ready access to these programs, and have relied on hand methods or consultants' worl. G. N. Clark's HYTAIN program and the earlier HYDRO and RETAIN versions have been used in combination with Dyer and Associates' FLOCOMP. We are aware of deficiencies in itial hydrograph part of HYTAIN and hope to obtain modifications. We are aware of,but have not accessed HYDROCOMP, UCUR, the EPA SWM model, the Corps of Engineers HEC series, and have very little knowledge of their details.

(2,3,0) STORM DRAINAGE SYSTEM DESIGN

(2,3,1) Open vs. Closed System: Enclosure is required for all systems up to a 72" size based on the 10-year storm. Exceptions may be made where there are natural stream values which can be preserved, an adequate easement to provide a surrounding buffer from abutting developed properties is available, and the layout and design are adequate to avoid future nuisances or maintenance problems. This use of open design may be a feature of cluster development. The building code requires by law the enclosure of streams up to the 72" size across developed properties.

(2,3,2) Computing Flow: See page 3 of this letter. Resistance "n" values in Manning Formula are prescribed for various materials in the WSSC 1964 criteria.

(2,3,3) Materials: Following WSSC requirements for design approval, reinforced concrete pipe is generally required. Corrugated steel pipe is permitted for rural highway and entrance culverts only, not directly connected to closed pipe systems. For larger structures, a variety of materials are permitted based on principles of best overall cost and serviceability, with emphasis on concrete. Open channel linings are generally concrete for least maintenance cost, however, greater awareness of aesthetic values and need to control velocities, especially at discharge points into natural streams, is leading to more use of rip-rap sod, gabions, and the like.

(2,3,4) Loadings: The AASHTO HS20-44 truck load is prescribed for all parts of the system in public right of way unless permanently out of reach of all vehicles. The H-10 load may be allowed within non-public access areas of private property. Pipe loads are computed using the techniques suggested by the U.S. Concrete Pipe Association for trench or projecting trench conditions, where necessary. WSSC 1964 criteria prescribe pipe classes based on ASTM C-76 for various depths of cover in roadway areas, with a minimum of class IV in the public right of way. Large structures are designed for HS20-44 using the AASHTO Specifications for Highway Bridges.

(2,3,5) Appurtenances: Standard details designed and prescribed by the WSSC 1964 criteria are used where poss ble. Alternative details may be those of the Maryland State Highway Administration. The MSHA details are required on Federal Aid highway projects. Special detail designs conform to AASHTO specifications for bridges and for urban streets.

(2,3,6) Retention and Detention: Each major drainage project and highway project is reviewed for possible detention opportunities. This is only a very recent practice and few examples have been constructed to date. Detention is not generally considered for fully enclosed systems, however it may be provided to keep inputs within capacity of existing downstream systems. Objectives of detention is usually to alleviate existing or potential downstream flooding and thus is designed to control large flows, usually the 50-year flood. Typical location of such a facility is the upstream side of the roadway embankment using natural or excavated flood plain storage and using the entrance to the drain system, culvert, or bridge as a control. At bridges, detention is rarely practical due to headwater limitations from nearby development, or due to resulting high velocity through the opening.

(2,3,7) Watershed Approach: We advocate analysis of the entire watershed including substantial downstream reaches for any SWM project, however, resources are rarely available to do this by proper hydrologic methods. Analysis of the overall situation by at least superficial methods is always done.

AGENCY/JURISDICTION: Environmental Planning Division, M-NCPPC
PERSON INTERVIEWED/RESPONDED: Mr. Edward Grenning
INTERVIEWING/CORRESPONDING TF MEMBER(S): W. Petzold
DATE: May 31, 1974 (INTERVIEW)

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) Definition of SWM - The control of storm water so as to minimize the damaging effects of flooding and to minimize the effect on water quality.

Goal - Adopt plans to abate the deleterious effects of flooding and decreased water quality.

(1, 2, 0) The major SWM program administered by the Environmental Planning Division is the development of Comprehensive Storm Water Management Plans for the county. A $190,000 study by the consulting firm of CH_2M/Hill of the Seneca and Muddy Branch watersheds was started in December, 1973, and is scheduled for completion in the fall of 1974. The study will provide:

(1) An environmental inventory of the flood plain.
(2) An analytical tool for determining the flood plain for various design storms.
(3) An evaluation of the risk to the environment at various design storm frequencies.
(4) A comprehensive plan for the watershed which will include recommended impoundment sites, a comparison of alternatives in land development and recommended legislative action.

Programs in SWM by other Park and Planning divisions include: The provision of on-site detention for recreation centers as required by SCS criteria. The maintenance of the existing major impoundments in the park areas with provision for sedimentation control. The requirement for permanent impoundments in accordance with adopted Master Plans is a feature of the newly adopted Germantown Master Plan.

(1, 3, 0) Park and Planning Budget for SWM

General Planning, Administration and Referrals	$ 25,000
Consultant study	$140,000

(1, 4, 0) One of the major weaknesses in the existing program is the absence of clear-cut responsibility for maintenance of storm water management structures. More staff would enable the Park and Planning Commission to respond more quickly to the SWM needs of the area.

(1, 5, 0) Much of the natural storage areas for storm water has been removed in the development process. There is a need to replace lost storage and to recharge ground water. There should be consideration of standards for the amount of pervious areas that remain after development.

(1, 6, 0) The SWM criteria for Montgomery County has been developed by the Soil Conservation District. A SWM preliminary plan is required along with the preliminary plan of subdivision and SWM is made a condition of the Park and Planning subdivision approval.

(1, 7, 0) Not applicable.

(1, 8, 0) Some structures in park areas are maintained by the Maryland-National Capital Park and Planning Commission Park Department.

(1, 9, 0) The building restriction line delineated on plats is required to be 25 feet from the 50 year flood plain computed on the basis of the ultimate planned development for the watershed.

AGENCY/JURISDICTION: Montgomery County DEP
PERSON INTERVIEWED/RESPONDED: Mr. Lewis H. Williams
INTERVIEWING/CORRESPONDING TF MEMBER(S): W. Petzold
DATE: May 1974 (INTERVIEW)

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) Definition of SWM - The collecting, conveying, storage, treatment and disposal of storm runoff in a manner to protect and enhance the environmental values of streams and stream valleys.

Goals and Objectives - Preserve water quality and maintain environmental amenities of streams and stream valleys through planning and implementing projects to retain run-off from urbanizing areas.

(1, 2, 0) Plan of Action (SWM Programs)
(a) Watershed Studies.
(b) Watershed systems plans and designs.
(c) Response to requests for improving specific reaches of streams in developed areas.
(d) Evaluation of proposed land use changes.
(e) Re-appraisal of on-site program.

(1, 3, 0) Department of Environmental Protection Budget for SWM (in thousands of dollars)

F.Y.	Adm. *	Study **	Const. **	Review Processing	Enforcement	Total
'74	57	410	281			
'75	60	445	1,129			
'76		510	2,603			
'77		320	1,795			
'78		320	1,792			
'79		160	885			
'80		125	705			

* Includes preliminary in-house study and design
** Figures from 6 yr. Capital Improvement Program
Does not inlcude design review by Soil Conservation Service.

Mr. Williams would like to see more budgeted for processing and enforcement. He foresees future growth in the construction and supervision phases.

(1, 4, 0) Recognized weaknesses in existing SWM program.

(a) On-site program has built-in maintenance problems. Recommendations concerning assurance of continued maintenance for private on-site systems are being prepared by the department. Standards and specifications for on-site systems are needed in addition to the interim criteria.

(b) The discrepancy in controlling a two-year design storm by on-site storm water management while the subdivision drainage system is designed to the ten-year design storm.

(c) A fragmented approach (on-site only with a few major impoundments) does not consider the effect on the entire system, e.g. there could be reinforcing peaks.

(1, 5, 0) Mr. Williams did not make an evaluation of specific techniques but did express dissatisfaction with the existing level of SWM implementation, operation and maintenance. All land use change and storm water management facilities should be coordinated and evaluated in terms of the total stream valley system. The studies authorized in the Capital Budget should provide the basis for this type of coordination.*

(1, 6, 0) Interim SWM criteria were adopted in June 1971 by the Montgomery Soil Conservation District. This criteria applies to all new subdivisions and buildings and requires on-site detention to control the two-year design storm. The agencies most directly involved are the MNCP&PC, the MSCD and the M.C. Dept. of Environmental Protection (through its Environmental Projects Section and Sediment Control Section). The M.C. Dept. of Transportation, Office of Planning and Capital Programming, and Maryland Dept. of Natural Resources (Water Resources Administration) are less directly involved.

(1, 7, 0) Recommendations are being prepared for study and future action on a policy that would provide for a more equitable mix of on-site and off-site detention with fee in lieu of actual construction.

(1, 8, 0) Recommendations are being prepared concerning maintenance of SWM facilities. They will include a requirement that they be placed in public easements.

(1, 9, 0) No construction or alteration is allowed in the 50 year flood plain except by permit from the Maryland Water Resources Administration. Subdivision regulations require a building restriction line 25 feet back from the 50 year flood plain limit (after total development of the watershed). An easement is generally required on the plat of subdivision that reserves the area for maintenance of drainage.

AGENCY/JURISDICTION: Maryland-National Capital Park and Planning Commission
PERSON INTERVIEWED/RESPONDED: Phil Hogue, G. Valodores, A. Viaris
INTERVIEWING/CORRESPONDING TF MEMBER(S): W. Caruthers, J. Morris, D. Chapman
DATE: April 16, 1974 (INTERVIEW)

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) In process of formulating goals / application of systems analysis to hydrologic phenomina to determine optimum land use distribution / flood and storm water control / water quality not a problem

Storm Water - wider terms - diffused water
Flood Water - water that flows outside the confines of the natural channel

Goals - proper management of water resources to protect life and property and maintain esthetics / prevent problems for starting

(1, 2, 0) Hydrologic watershed modeling of Anacostia Basins / Preparation of on-site criteria / Sponsor of Piscataway 566 Program / Sponsor Matawoman 566 Program / Liason for US Army Corps of Engineers reports /

Budget is about 1/3 of environmental planning = $25,000

(1, 3, 0) Breakdown to be sent later

(1, 4, 0) Major problems are money and staff limitations

(1, 5, 0) No / are moving in proper direction / looking at regional approach /

(1, 6, 0) Yes - obtained copy / State Water Resources Administration is involved

(1, 7, 0) Blanket requirement for everyone to get involved

(1, 8, 0) Not involved in maintenance or modification

(1, 9, 0) Flood plain is where high water reaches not merely elevation / cannot remove building from flood plain by raising building above high water / parking lots and ballfields would be compatible utilization of flood plains / do need to look at consequences of looking at something as against doing nothing

AGENCY/JURISDICTION: Washington Suburban Sanitary Commission
PERSON INTERVIEWED/RESPONDED: Mr. Dick Plantholt
INTERVIEWING/CORRESPONDING TF MEMBER(S): W. Caruthers, J. Morris, D. Chapman

DATE: April 9, 1974 (INTERVIEW)

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) Handling storm water in a manner that does not damage developed property / constructing devices that will offset effects of increased runoff. / WSSC is more concerned with flooding than soil erosion / Goals are not really defined at this time / SWM will become part of policy

(1, 2, 0) Storm Water Technical Review and Coordinating Committee has been set up to develop a program / Several flood control studies are under way; Indian Creek, Henson Creek, include dentention basins / Prince Georges County Flood Task Force - set up by council resolution / Study on Northwest Branch - intent of study is to find solution to existing problem and prevent future problems / Budget: Indian Creek - $40,000
Bold Hill Creek - $20,000

Most fall in $20-50,000 range
annual - $20,000 for last 5 years

(1, 3, 0) No real breakdown available / Need is recognized - proportions will increase

(1, 4, 0) Program is in infancy / initial weakness - large number of agencies involved could be a strength later on

(1, 5, 0) Still using "Rational Formula" / Not really satisfied / Do not have any special technique

(1, 6, 0) Do not have firm criteria

(1, 7, 0) Subject is presently under study

(1, 8, 0) Presently, all dentention systems are on-site / Hold maintenance bonds where S.W.M. system is in public r/w / would like to see all dentention systems under public control? /

(1, 9, 0) Keep development out of the flood plain / Flood plain based on 50 year frequency storm with ultimate development upstream and no management / County approves flood plain limits / WSSC approves plans / Inspected jointly with county

AGENCY/JURISDICTION: Metropolitan Washington Council of Governments
PERSON INTERVIEWED/RESPONDED: Mr. Dennis R. Bates
INTERVIEWING/CORRESPONDING TF MEMBER(S): E. Y. Liou
DATE: June 25, 1974

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) Our goal is to get storm water induced pollution to be recognized in programs to improve stream water quality.

(1, 2, 0) Computer programming models to predict the effects of sea water on water quality in the Potomac Estuary - About $40,000

(1, 3, 0) All in (a) - we are happy with it that way - our role is a planning agency.

(1, 4, 0) More needs to be known about pollution loads in stormwater.

(1, 5, 0) No - there are not any. More attention paid to reducing loads at their source, more attention paid to street cleaning.

(1, 6, 0) No.

(1, 7, 0) While we have not really gone into this in depth. We think on-site detention should be required as part of a subdivision or building/zoning code.

(1, 8, 0) N/A

(1, 9, 0) Discourage the planning of development in them, encourage preservation of selected stream beds as open space.

(2, 0, 0) Questionnaire on Design Review

(2, 1, 0) PRECIPITATION

(2, 1, 1) We consider storms that occur far more frequently than is usually the concern of those who deal with storm piping problems. About 8 per year.

(2, 1, 2) Not spatial, but temporal is important in considering periods of waste accumulation between storms.

(2, 1, 3) No.

(2, 1, 4) Weather Office tapes.

(2, 1, 5) Very crudely - we assign imperviousness ratings to various land uses.

(2, 2, 0) RUN-OFF - We use the EPA SWM Model

(2, 3, 0) STORM DRAINAGE SYSTEM

(2, 3, 1) N/A

(2, 3, 2) N/A

(2, 3, 3) N/A

(2, 3, 4) N/A

(2, 3, 5) N/A

(2, 3, 6) For treatment simulations only.

(2, 3, 7) Yes.

AGENCY/JURISDICTION: District of Columbia DES
PERSON INTERVIEWED/RESPONDED: Mr. Charles R. Martin
INTERVIEWING/CORRESPONDING TF MEMBER(S): E. Y. Liou
DATE: July 1, 1974 (LETTER)

(2, 0, 0) Questionnaire on Design Review

(2, 1, 0) PRECIPITATION

(2, 1, 1) In general, a 15-year design frequency is selected for storm sewers. In special cases, when economically justified, a less frequent (more intense) rainfall may be selected for design.

(2, 1, 2) See answer to question-2 below.

(2, 1, 3) The effect of a moving rainstorm is not considered.

(2, 1, 4) The rainfall-frequency curves that have been adopted by the department were determined in a comprehensive study of U.S. Weather Bureau records of intense rates of precipitation in the District for the 60-year period from 1894 thru 1954.

(2, 1, 5) Infiltration is not considered in the design of storm sewers.

(2, 2, 0) RUN-OFF

(2, 2, 1) The rational method is used to compute peak run-off.

(2, 2, 2) In the rational method, run-off is related to rainfall intensity by the formula

$$Q = C\ i\ A.$$

Where:
Q = Peak rate of run-off, in cfs.
C = Coefficient of run-off.
i = Intensity of rainfall, in inches per hour.
A = Tributary area, in acres.

Boundaries of the drainage area are established by field surveys or from suitable maps. The complete drainage area is subdivided into component parts, each tributary to a point of inlet.

Coefficients of run-off are selected or estimated which are appropriate for the land use and development expected as of the year 2000. These coefficients are assumed to remain constant throughout the duration of the storm and are based on the percentage of impervious surface in the tributary area. The following values are currently used:

C = 0.30 for pervious surfaces,
C - 0.90 for impervious surfaces.

In general, inlet time is assumed to be 10 - minutes. However, in some cases it may be assumed as more or less than 10 - minutes, depending on local conditions.

Time of concentration is equal to inlet time plus the time of flow in the sewer from the most remote inlet to the point under consideration.

In computing the quantity of run-off for areas of 500 acres and larger, rainfall intensity is reduced by a "distribution factor".

(2, 2, 3) See answer to question - 2 above.

(2, 2, 4) Total volume of run-off and its time distribution are not generally determined.

(2, 2, 5) Flood flow is not generally routed through the drainage system.

(2, 2, 6) Departmental efforts in mathematical modeling have been limited to preliminary studies.

(2, 3, 0) STORM DRAINAGE SYSTEM

(2, 3, 1) Decision on whether to use an open channel system or closed conduit system is based on function of the proposed system and local conditions.

(2, 3, 2) Manning's formula is used to compute flow through a drainage system. For precase concrete pipe, the value of the coefficient of friction, n, is generally assumed to be 0.015 for sewers 24-in. and less in diameter and 0.013 for sewer 27-in. and larger. For other types of construction, type of joint and conduit material are considered in the selection of a coefficient.

(2, 3, 3) Precase reinforced - concrete pipe is generally recommended for sewers 78-in. and smaller in diameter. For larger sewers, monolithic reinforced concrete may also be considered as an alternate. Flow characteristics; life expectancy; resistance to scouring; ease of handling and installation; physical strength; type of joint; availability in sizes required; and cost of materials, handling, and installation are factors considered in the selection of materials for sewer construction.

(2, 3, 4) Loading conditions, conduit material, shape, and rigidity are among the factors considered in selecting criterion to be followed to determine loads on closed conduits. ASCE Manual No. 37 (WPCF Manual No. 9), industry handbooks, and textbooks on Soil Mechanics are sources of the methods used.

(2, 3, 5) The DES Design Manual is generally followed in the design of appurtenances for storm drainage systems. Copies are not available for public distribution.

(2, 3, 6) Consideration of retention/detention facilities has been limited to preliminary studies.

(2, 3, 7) Yes, in order to prevent piece - meal drainage construction which at a later date may be found inadequate and/or incompatible.

AGENCY/JURISDICTION: Fairfax County, Virginia
PERSON INTERVIEWED/RESPONSED: Mr. F. Payne Johnson
INTERVIEWING/CORRESPONDING TF MEMBER(S): F. Payne Johnson
DATE: May 1974

(1, 0, 0) Questionnaire for Public Agencies

(1,1,0) Fairfax County's definition of storm water management is based on the overall philosophy of storm water and run-off to be utilized as many ways as possible for the County before passing it into downstream channels. The County's goal in storm water management is to develop a County-wide storm drainage plan that will effect the philosophy set forth above.

(1,2,0) In 1972 the County retained Parsons, Brinckerhoff, Quade and Douglas, Inc. consulting engineers, to prepare the County-wide storm drainage plan that considered storm water a resource to be used as many ways for the County before passing it into downstream channels.

In September 1972, the Board adopted a policy that require storm water detention facilities to be incorporated in all site and development plans submitted after October 15, 1972. The County approved an $11,000,000.00 bond for storm drainage prior to retaining the consultants as setforth above.

(1,3,0) (a) Approximately $1,500,000.00 of the drainage bond has been spent or obligated on the storm water namagement study now being conducted by the consultants. (b) Plan review fees are charged to all developers for review and processing of development plans that include storm water detention facilities. (c) Plan review fees cover the cost of inspection of detention facilities now being constructed by developers. (d) _____ of the storm water bond funds have been spent to date, for storm drainage construction by the County. Additional bond funds will be voted if current bond funds are not adequate to complete the County's storm water management plan.

(1,4,0) The one weakness in our current program is the fact that the consultants report on the County-wide drainage plan will not be complete until 1977 and the rainfall and run-off information now being collected at approximately 30 stations in the County will not be available to establish final drainage design criteria until 1977.

(1,5,0) Since the County staff had to assemble detention techniques and methods of detention design rather hurridly to compy with the Board's directive of September 1972 and since the currently used criteria was developed from the Denver Report prepared by Wright and McLaughlin, practices in Montgomery County and the many available engineering methods, our limited experiences will naturally prove that some of the methods now being used should be abandoned and others expanded. Only time and experience can prove the weaknesses and strength of the current criteria.

(1,6,0) Copies of the current criteria is attached hereto. No other agencies are involved in the County's program.

(1,7,0) The County now has a pro rata share program where developers are charged a fee for off-site drainage improvements in certain selected drainagesheds. The consultants propose to establish a County-wide pro rata share program for implementing storm water management in their final report.

(1,8,0) Methods of storm water management structures on site plans are a responsibility of the landowner. The County requires that the landowner execute an agreement agreeing to maintaining these structures and in the event he fails to do so, the County may enter upon the property to perform emergency maintenance and bill the landowner for such maintenance. In single lot subdivisions, the storm sewer management structures are located in easements dedicated to the County and are maintained by the County.

(1,9,0) The County has had the U.S.Geological Survey to establish flood plains in major drainagesheds where any development or filling occures in an established flood plain the developer is required to provide channel improvements in flood plains which will not increase the upstream established flood plain limit.

(2,0,0) QUESTIONNAIRE ON DESIGN REVIEW

(2,1,0) PRECIPITATION

(2,1,1) The County's policy for many years has been to design storm sewer for the 10-year frequency storm. Flood Plains are delineated based on the 100-year frequency storm. Storm Water detention facilities are now designed on a 10-year 2 hour storm of 3 inches and checked against a 10-year, 100-year storm of 3 inches. Auxiliary drainage is checked against the 100-year storm and no structures are permitted within the 100-year flood limit.

(2,1,2) We do not consider the spatial as well as temporary variations of the storm.

(2,1,3) We do not consider the effect of a moving rain storm.

(2,1,4) Fairfax County is now using rainfall frequency curves prepared by the U. S. Weather Bureau of Washington, D. C.

(2,1,5) Infiltration is not normally considered in the design of storm drainage.

(2,2,0) RUN-OFF

(2,2,1) If a drainage area is up to 200 acres, run-off is determined by the rational method and for drainage areas in excess of 200 acres, run-off is determined by the Anderson Formula developed for Fairfax County by Dan Anderson of U. S. Geological Surveys ($Q=230\ KRA\ xT - 0.48$) based on actual rainfall and run-off data collected by the Geological Surveys in Fairfax County. Road culverts are generally designed for 50 year rainfall frequency under primary roads, 25-year rainfall frequency on secondary roads and 10-year rainfall frequency on all other locations. All culverts are checked for the effects of the 100-year storm and except in exceptional cases, structures are not permitted to be constructed below the 100-year flood level.

(2,2,2) The attached Public Facilities Manual sets forth in detail the perimeters used in the design method set forth in number one.

(2,2,3) Time of concentration for business and commercial development is usually assumed to be 5 minutes. Townhouse and apartment developments time of concentration is 5 to 10 minutes. Schools, Churches and single family lots, a time of concentration of 10 to 15 minutes is used. For drainage areas over 200 acres, the Anderson method is used to determine the time of concentration.

(2,2,4) When storm sewer detention facilities are installed, hydrographs are used to determine the total time of run-off and its time distribution.

(2,2,5) Any flood flow is routed through the drainage system, the County accepts methods of flooding routed contained in the standard hydraulics literature.

(2,2,6) We do not at this time compute storm run-off. However, Parsons, Brinckerhoff, Quade and Douglas drainage study now being made will provide computer models for each drainageshed.

(2,3,0) STORM DRIANAGE SYSTEM

(2,3,1) It is current County policy to use natural open channel systems wherever possible and only to install closed conduit systems in dense urgan areas.

(2,3,2) Flow through drainage systems are normally computed by the Manning Formula and "n" factor of .013 in concrete pipe, .015 in concrete ditches and box culverts, .03 in hand placed ri-rap places and .035 in dumped rip-rap channels.

(2,3,3) We normally use rainforced concrete pipe, reinforced concrete box culverts for drainage ditches and rip-rap lined and grass lined open channels. Corrugated metal pipes is permitted at certain locations for culverts.

(2,3,4) In conduit systems, we use the Virginia Department of Highways standards for loading on conduit.

(2,3,5) We normally use the Virginia Department of Highways specifications and standards for appurtenances for storm drainage systems. Our main reason for this is that all the streets constructed by developers in Fairfax County are taken into the Virginia Department of Highways secondary road system. We are presently encouraging the use of pre-cast concrete used of structures that have been approved by the Virginia Department of Highways and we feel that within the not too distant future, practically 90% of the structures used will be precast.

(2,3,6) We are now requiring detention facilities in practically all our drainage systems where feasible.

(2,3,7) We are using the watershed approach made in evaluating the storm water management project.

AGENCY/JURISDICTION: City of Fairfax, Virginia
PERSON INTERVIEWED/RESPONDED: Mr. James R. Shull
INTERVIEWING/CORRESPONDING TF MEMBER(S): F. Payne Johnson
DATE: Dec. 1974 (LETTER)

(1, 0, 0) Questionnaire for Public Agencies

(1, 1, 0) This is a plan with implementation of solving existing and future problems.

(1, 2, 0) 1) Detention of storm water.
2) Stream cleaning and channel realignment.
3) About $25,000 per year.

(1, 3, 0) (a) None.
(b) Yes.
(c) Yes.
(d) Yes.
Only about $25,000 appropriated for construction. That's it, but fund should be appropriated for additional manpower for enforcement.

(1, 4, 0) Yes.

(1, 5, 0) Yes, with an exception to enforcement.

(1, 6, 0) No.

(1, 7, 0) ?

(1, 8, 0) None at this time, but a bond is being proposed.

(1, 9, 0) We have a flood plain ordinance that permits construction in a flood plain if the developer provides adequate drainage and flood free structures.

(2, 0, 0) Questionnaire on Design Review

(2, 1, 0) PRECIPITATION

(2, 1, 1) Borrowed Fairfax County's criteria which appears acceptable for this area!

(2, 1, 2) No!

(2, 1, 3) No.

(2, 1, 4) Fairfax County's.

(2, 1, 5) Yes---In determination of runoff factors and storm water detention.

(2, 2, 0) RUN-OFF

(2, 2, 1) Rational.

(2, 2, 2) Time of concentration and various storm frequencies for a particular design.

(2, 2, 3) Slope and ground cover.

(2, 2, 4) Hydrographs.

(2, 2, 5) No.

(2, 2, 6) No.

(2, 3, 0) STORM DRAINAGE SYSTEM

(2, 3, 1) Economics, appearance and amount of flow.

(2, 3, 2) Manning formula, Use the established resistance coefficient for this area.

(2, 3, 3) Concrete, transite, coated steel galvanized and aluminum.

(2, 3, 4) No.

(2, 3, 5) Fairfax County and Virginia Department of Highways.

(2, 3, 6) 1) To reduce further aggrevation to our inadequate system.
2) Any new development
3) Throughout the City

(2, 3, 7) Not in this City as of this date.

AGENCY/JURISDICTION: City of Alexandria
PERSON INTERVIEWED/RESPONSED: S. K. Chan
INTERVIEWING/CORRESPONDING TF MEMBER(S): W. R. Elliott
DATE: June 6, 1975 (LETTER)

(1, 1, 0) Questionnaire for Public Agencies

(1, 1, 0) Controlling storm run-offs and stream flows to reduce downstream erosion problems, reduce the capital cost of the drainage system, and eliminate flooding and environmental problems.

(1, 2, 0) Watershed studies, detention/retention design; design and study improvements of streams in developed areas, review of capital projects to insure enforcement of SWM.

Operating Budget	$125,000/Year
Capital Budget	$3,000,000/Year

(1, 3, 0)

Study	20%
Review & Processing Plan	20%
Enforcement	5%
Construction	55%

(1, 4, 0) We do not know yet.

(1, 5, 0) We are still experiencing the SWM technique.

(1, 6, 0) No.

(1, 7, 0) N.A.

(1, 8, 0) S.W.M. Structures placed in public R/W and easements.

(1, 9, 0) Enforce Federal Flood Insurance Regulations.

AGENCY/JURISDICTION: City of Alexandria, Virginia
PERSON INTERVIEWED/RESPONDED: Mr. M. M. Halim
INTERVIEWING/CORRESPONDING TF MEMBER(S): F. Payne Johnson
DATE: March 25, 1975 (LETTER)

(2, 0, 0) Questionnaire on Design Review

(2, 1, 0) PRECIPITATION

(2, 1, 1) 10-Year frequency for storm sewers.
25-50 Year frequency for channels.
50-100 Year frequency for culverts.

(2, 1, 2) No.

(2, 1, 3) No.

(2, 1, 4) Washington National Airport rainfall intensity-duration-frequency curves.

(2, 1, 5) Yes. It is coupled in the runoff coefficient C.

(2, 2, 0) RUN-OFF

(2, 2, 1) Rational method (Q c.f.s. = CIA)

(2, 2, 2) C Runoff-Coefficient, according to zoning regulations for ultimate development.
I Intensity in In./Hr., from Washington National Airport rainfall intensity curve.
A Area in acres, by measuring from map.

(2, 2, 3) Generally 10 minutes; however, for big areas it is to be calculated by empirical charts taking into consideration distance, slope and nature of existing ground.

(2, 2, 4) Total volume of runoff and its time distribution = Q originated from the furthest remote area in the shed, plus other Q's meeting the main Q, and calculated according to the main time of concentration plus time elapsed by main Q to point under consideration.

(2, 2, 5) No.

(2, 2, 6) Yes.
No.

(2, 3, 0) STORM DRAINAGE SYSTEM

(2, 3, 1) Yes, depending on nature of area and zoning. For example, it is preferable that big streams in residential areas be underground; on the other hand, in natural or scenic areas, it is preferable to maintain natural streams above ground.

(2, 3, 2) Manning's Formula, and the resistance coefficient, is taken from standard tables.

(2, 3, 3) Concrete.

(2, 3, 4) Manston theory for estimating earth loads and the Boussinesq solution for stress distribution from live loads.

(2, 3, 5) Yes, City of Alexandria Standard Specifications for Construction.

(2, 3, 6) Yes, in order not to overload existing natural streams where they cannot handle flow from all developed areas related to its shed.

(2, 3, 7) Yes.

INITIAL DISTRIBUTION LIST

Mr. Frank Lamm
Director of Water Resource Planning
Metropolitan Washington Council of Governments
1225 Connecticut Avenue, N. W.
Washington, D. C. 20036

Washington Center for Metropolitan Studies
1717 Massachusetts Avenue, N. W.
Washington, D. C. 20036

Interstate Commission on the Potomac River Basin
4350 East-West Towers, Suite 814
Bethesda, Maryland 20014

U. S. Geological Survey
5110 College Avenue
College Park, Maryland 20740

Mr. Frank Sessions
NCS-ASCE Water Resources Engineering Committee
c/o U. S. Geological Survey
Mail Stop 406
Reston, Virginia 22092

Mr. Norman Cooper, Chairman
Technical Div. - NCS-ASCE
Office of the Secretary
Dept. of Transportation
400 7th Street, S. W. - Room 9422
Washington, D. C. 20590

Mrs. Kay Morrison
National Capital League of Women Voters
1215 Fallsmead Way
Rockville, Maryland 20854

Dept. of Civil Engineering
Howard University
Washington, D. C. 20001

Mr. Malcolm Hope, Director
D. C. Office of Environmental Planning
Presidential Bldg.
415 12th Street, N. W.
Washington, D. C. 20014

School of Engineering and Applied Science
George Washington University
Washington, D. C. 20006

Department of Civil Engineering
Catholic University
Pangborn Building
Washington, D. C. 20019

Department of Engineering
Federal City College
929 E Street, N. W.
Washington, D. C. 20004

Hon. Walter E. Washington, Mayor
District of Columbia
District Building
Washington, D. C. 20004

Honorable Sterling Tucker, President
Washington City Council
District Building,
14th and E Streets, N. W.
Washington, D. C. 20004

Mr. Graham Munkittrick
USDA Soil Conservation Service
Room 522
4321 Hartwick Road
College Park, Maryland 20740

Potomac Chapter
National Society of Professional Engineers
c/o Mr. Edward East, P. E.
4213 Stafford Road
Olney, Maryland 20832

Dr. Everett C. Carter
Department of Civil Engineering
University of Maryland
College Park, Maryland 20742

Maryland Association of Soil Conservation Districts
c/o Mr. Wilbert R. Paul
Route 1, Box 116
Mt. Savage, Maryland 21545

Water Resources Administration
Maryland Dept. of Natural Resources
Tawes State Office Building
Annapolis, Maryland 21401
Attn: Mr. Robert S. Norton, Jr.

Maryland State Soil Conservation
Committee
c/o Mr. Arnold Hawkins, Exec. Sec.
Md. Dept. of Agriculture
Parole Plaza Office Building
Annapolis, Maryland 21401

Old Line Chapter,
Soil Conservation Society
Bob Ziehm, Sec. Treas.
USDA-SCS District Office
9051 Baltimore National Pike
Ellicott City, Md. 21043

Mr. Michael P. DeChant
Technical Director
Suburban Maryland Home Builders Assoc.
9517 Georgia Avenue
Silver Spring, Maryland 20910

Mr. Ed. Carlin
Suburban Maryland Engineers Society
c/o Basis, Carlin and Assoc., Inc.
9332 Annapolis Road
Lanham, Maryland 20801

Hon. Charles E. Beatly, Jr., Mayor
City of Alexandria
City Hall, P. O. Box 178
125 N. Royal Street
Alexandria, Virginia 22313

Mr. Dayton L. Cook
Director of Public Works
City Hall, P. O. Box 178
Alexandria, Virginia 22180

Hon. John W. Purdy, Chairman
Arlington County Board
County Courthouse
Arlington, Virginia 22201

Mr. Bert W. Johnson
County Manager
County Courthouse
Arlington, Virginia 22201

Mayor, City of Bowie
City Building
12205 Tulip Grove Drive
Bowie, Maryland 20715

Hon. Nathaniel F. Young, Mayor
City of Fairfax
City Hall
Fairfax, Virginia 22030

Hon. John F. Herrity, Chairman
Fairfax County Board of Supervisors
Massey Building
4100 Chain Bridge Road
Fairfax, Viriginia 22030

Hon. Milton M. Walker, Mayor
City of Gaithersburg
31 S. Summit Avenue
Gaithersburg, Maryland 20760

Hon. James P. Gleason
Montgomery County Executive
County Office Building
Rockville, Maryland 20850

Hon. Norman L. Christeller, President
Montgomery County Council
County Office Building
Rockville, Maryland 20850

Hon. William E. Hanna, Jr., Mayor
City of Rockville
City Hall
Rockville, Maryland 20850

Mr. Ward L. Rothgeb, Director
Department of Public Works
City Hall
Rockville, Maryland 20850

City of College Park
Administration Building
4500 Knox Road
College Park, Maryland 20740

City of Greenbelt
25 Crescent Road
Greenbelt, Maryland 20770

City of Takoma Park
Municipal Building
7500 Maple Avenue
Takoma Park, Maryland 20012

City of Vienna
Town Hall
Vienna, Virginia 22180

Hon. Winfield M. Kelly, Jr.
County Executive
Courthouse
Upper Marlboro, Maryland 20870

The Prince George's County Council
County Chourthouse
Upper Marlboro, Maryland 20870

Mr. Donald Dunker, Director
Dept. of Public Works and Transportation
8400 D'Arcy Road
Forestville, Md. 20028

Prince George's Soil Conservation District
15209 Main Street
Upper Marlboro, Maryland 20870

Prince George's County Planning Board
Maryland-National Capital Park and
Planning Commission
6600 Kinilworth Avenue
Riverdale, Maryland 20840

Dr. Floyd Peterson, P. E., Chairman
Washington Suburban Sanitary Commission
4017 Hamilton Street
Hyattsville, Maryland 20781

Mr. Royce Hansen, Chairman
Montgomery County Planning Board
Maryland-National Capital Park and
Planning Commission
8787 Georgia Avenue
Silver Spring, Maryland 20910

Mr. Clay Ervine, Director
Dept. of Environmental Protection
Montgomery County
6110 Executive Boulevard
Rockville, Maryland 20852

Montgomery Soil Conservation District
6110 Executive Boulevard
Rockville, Maryland 20852

League of Women Voters of Montgomery
County
1047-R Rockville Pike
Rockville, Maryland 20852

American Association of University
Women Interbranch Council
c/o Mrs. Kral Frank
883 Azaela Drive
Rockville, Maryland 20850

Montgomery County Committee
Maryland Environmental Trust
c/o Sally Kanchuger
10908 Piscasso Lane
Potomac, Maryland 20854

Maryland State Division of the
Issac Walton League of America
6700 Needwood Road
Derwood, Maryland 20855

Northern Virginia Conservation Council
Mr. Tom Gause, President
6900 Oak Court
Annandale, Virginia 22003

Fairfax Environmental Quality
Advisory Council
Mr. Ross Hardter, Chairman
7501 Range Road
Alexandria, Virginia 22306

Fairfax Stream Valley Board
Mary Margaret Goodwin, Chairman
11391 Dorcey Place
Lorton, Virginia 22079

Fairfax County Park Authority
Joseph P. Downs, Director
4030 Hummer Road
Annandale, Virginia 22003

Northern Virginia Regional Park Authority
William Lightsey, Director
11001 Popes Head Road
Fairfax, Virginia 22030

Virginia Soil and Water Conservation Com
mission
Joseph B. Willson, Jr., Director
830 E. Main Street, Suite 800
Richmond, Virginia 23219

Fairfax County Water Authority
James J. Corbalis, Jr., Director
4121 Chatelain Road
Annandale, Virginia 22003

Northern Virginia Planning District Commission
John Eppling, Director
7309 Arlington Boulevard
Falls Church, Virginia 22042

Fairfax Office of Environmental Affairs
Donald R. Bowman, Director
4100 Chain Bridge Road
Fairfax, Virginia 22030

Northern Virginia Soil and Water Conservation District
Robert E. Keating, Chairman
District Executive - Charles J. Koch
3945 Chain Bridge Road, Suite B
Fairfax, Virginia 22030

Sen. T. Glenn Beall, Jr.
458 Old Senate Office Building
Washington, D. C. 20510

William Colony,
Coordinator for Wash. Metro & Va. State Areas
Environmental Protection Agency
1140 River Road
Charlottesville, Va. 22901

Del. Walter Fauntroy
506 Cannon House Office Building
Washington, D. C. 20515

Rep. Gilvert Gude
332 Cannon House Office Building
Washington, D. C. 20515

William Hussmann
Chief Administrative Officer
County Office Building
100 Maryland Avenue
Rockville, Maryland 20850

Sen. Charles McC. Mathias
240 Old Senate Office Building
Washington, D. C. 20510

Rep. Joseph L. Fisher
Room 318, Cannon Office Building
Washington, D. C. 20515

K. A. Godfrey, Jr., Editor
Civil Engineering Magazine
345 East 47th Street
New York, N. Y. 10017

Rep. Herbert E. Harris
Room 1229, Longworth Office Bldg.
Washington, D. C. 20515

Frank E. Stratton, Editor
ASCE/EED Newsletter
Dept. of Civil Engineering
San Diego State University
San Diego, California 92115

Hon. Alexander B. Bell
House of Delegates Office Building
Annapolis, Maryland 21401

Hon. Kay G. Bienen
House of Delegates Office Building
Annapolis, Maryland 21401

Hon. Peter A. Bozick
Senate Office Building
Annapolis, Maryland 21401

Hon. Arthur Dorman
Senate Office Building
Annapolis, Maryland 21401

Dr. Robert H. Harris
Environmental Defense Fund
1525 18th Street, N. W.
Washington, D. C. 20036

John F. Herrity, President
Fairfax County Board of Supervisors
6623 Backlick Road - Room 211
Springfield, Virginia 22150

Hon. Craig S. Knoll
House of Delegates Office Building
Annapolis, Maryland 21401

Hon. William R. McCaffrey
House of Delegates Office Building
Annapolis, Maryland 21401

Col. Robert S. McGarry, District Engineer
Baltimore District
U. S. Army Corps of Engineers
P. O. Box 1715
Baltimore, Maryland 21203

Hon. S. Frank Shore
House of Delegates Office Building
Annapolis, Maryland 21401

Hon. Judith C. Toth
House of Delegates Office Building
Annapolis, Maryland 21401

Hon. C. Lawrence Wiser
Senate Office Building
Annapolis, Maryland 21401

Arlington Journal
331 North Fairfax
Alexandria, Virginia 22300

Sentinel Newspapers
Comprint Lane
Gaithersburg, Maryland 20760

The Washington Star
224 Virginia Avenue, S.E.
Washington, D.C. 20003

WMAL-TV, Channel 7
4461 Connecticut Avenue, N.W.
Washington, D.C. 20008

WRC-TV, Channel 4
4001 Nebraska Avenue, N.W.
Washington, D.C. 20016

WTOP-TV, Channel 9
4001 Brandywine Street, N.W.
Washington, D.C. 20016

WTTG, Channel 5
5151 Wisconsin Avenue, N.W.
Washington, D.C. 20016

Dale Jones
State Water Control Board
P. O. Box 11143
Richmond, Virginia 23230

Fairfax Office of Environmental Management
John Yaremchuck, Director
4100 Chain Bridge Road
Fairfax, Virginia 22030

The Montgomery Journal
6935 Wisconsin Avenue
Bethesda, Maryland 20015

Northern Virginia Sun
1227 N. Ivy Street
Arlington, Virginia 22210

Prince George's Post
4623 Baltimore Avenue
Hyattsville, Maryland 20781

Prince George's Journal
7100 Baltimore Avenue
College Park, Maryland 20740

Hon. Clive L. DuVal II
2007 N. 15th Street
Arlington, Virginia 22201

Hon. Edward M. Holland
2054 N. 14th Street
Arlington, Virginia 22216

Hon. Vincent F. Callahan, Jr.
6631 Old Dominion Drive
McLean, Virginia 22101

Hon. James H. Dilliard
4709 Briar Patch Lane
Fairfax, Virginia 22030

Hon. Wyatt B. Durrette, Jr.
Equity Building, Suite 300
4085 Chain Bridge Road
Fairfax, Virginia 22030

Hon. Mary A. Marshall
2256 N. Wakefield Street
Arlington, Virginia 22207

Hon. Thomas J. Rothrock
P. O. Box 325
Fairfax, Virginia 22030

The Washington Post
1150 15th Street, N.W.
Washington, D.C. 20005

Hon. Joseph V. Gartian, Jr.
1801 K Street, N.W.
Washington, D.C. 20006